Non-responsive

[redacted]

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

APR 2 0 2005

REPLY TO THE ATTENTION OF.

Judith Gorog, Chief Financial Officer
Ugitech S.A.
Avenue Paul Girod
73403 Ugine
France

Re: Techalloy Company, Inc.
Financial Assurance for Corrective Measures Implementation

Dear Ms. Gorog:

In response to a request from your attorney, the U.S. EPA is providing you with this letter regarding the financial assurance which Ugitech S.A. has been providing for implementation of RCRA corrective action being performed at the Techalloy Company, Inc., facility in Union, Illinois. This RCRA corrective action is being performed by Techalloy Company pursuant to an Administrative Order on Consent, EPA Docket No. R8H-5-99-008, (AOC). Section XXII of the AOC requires that Techalloy Company provide $3 million in financial assurance.

To date, the $3 million financial assurance has been provided by Ugitech S.A., and its corporate predecessor Ugine Savoie Imphy, through a corporate guarantee. That corporate guarantee was originally established on August 28, 2000, by Ugine Savoie Imphy. Through your attorney, you have informed us that on February 8, 2005, 100% of the stock of Techalloy Company, Inc., was sold by Ugitech S.A. to Central Wire Industries, Ltd., a Canadian company, and that Techalloy Company and its new corporate parent are required by the stock purchase agreement to establish an alternate form of financial assurance under the AOC.

In connection with your request that the U.S. EPA provide you with this letter, we note that in a November 23, 2004, letter the U.S. EPA approved a reduction in the amount of financial assurance required for the Techalloy Company facility, to $561,000. We also note that Techalloy Company has established an irrevocable standby letter of credit to provide this reduced financial assurance, effective February 8, 2005. While Section XXII of the AOC has not yet been modified to reflect this reduction in the amount of financial assurance, we do not consider that an obstacle to providing you with this letter.

Therefore, based on the information mentioned above, the U.S. EPA hereby releases Ugitech S.A. from any future obligation under the AOC to provide financial assurance for the Techalloy Company facility in Union, Illinois.

Sincerely,

for

Margaret M. Guerriero, Director
Waste, Pesticides and Toxics Division
Region 5, U.S. EPA

cc: Margaret Rosegay, Pillsbury Winthrop (by fax and mail)

OFFICE OF REGIONAL COUNSEL CONCURRENCE SHEET

SUBJECT: Letter Regarding CMI Financial Assurance Techalloy Company, Union, Illinois

CONTROL NO. (if applicable): ______

Originator and first level supervisor are responsible for assuring that documents are in plain language. All other reviewers should consider plain language in their reviews. *See* plain language checklist on reverse side of this sheet.

Originator	(J. Miller	) JM	Date 4/13/05
~~Section Chief~~	(	)	Date
~~Branch Chief~~	(~~Nelson/Cohen~~	)	Date
~~Deputy RC~~	(~~Frey~~	)	Date
~~Regional Counsel~~	(~~Frey (Acting)~~	)	Date

COMMENTS: ______

(PLEASE INDICATE NAME OF APPROPRIATE DIVISION(S) WHERE CONCURRENT SIGNOFF IS NECESSARY)

NAME OF DIVISION WPTD

Assigned Staff Person	(B. Sundar	) B. Sundar	Date 4/14/05
Other	(G. Hamper	) G. Hamper	Date 4-14-05
Other	(G. Phillips	) G. Phillips	Date 4/18/05
Division Director	(Guerriero	) BB for	Date 4/19/05

OFFICE OF THE REGIONAL ADMINISTRATOR

Other	(	)	Date
Other	(	)	Date
Deputy Regional Administrator	(Mathur	)	Date
Regional Administrator	(Skinner	)	Date

Sen 4/18/05

COMMENTS: ______

RETURN TO ORC-Cheryl Klebenow (886-6771)(C-14J) 11/04/03 Version

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

REPLY TO THE ATTENTION OF

December 6, 2005

David Novitski
Thelen Reid & Priest LLP
333 South Hope Street, Suite 2900
Los Angeles, California 90071-3048

Re: Techalloy Company facility in Union, Illinois;
Modification to EPA Consent Order

Dear Dave:

Attached is one fully-executed copy of the Modification to Administrative Order on Consent between the U.S. EPA and Techalloy, U.S. EPA Docket No. R8H-5-99-008.

Techalloy now should proceed with signing the Standby Trust Agreement with Wells Fargo Bank. We already have agreed as to the form of that Standby Trust Agreement (a copy was sent to you with my October 19th letter). The Modification requires that Techalloy enter into a standby trust agreement within 30 days of the effective date of the Modification. As the effective date of the Modification is November 29, 2005, which is the date that the U.S. EPA signed it, Techalloy must enter into a standby trust agreement no later than December 29, 2005.

Please mail me an original, signed, copy of the fully-executed Standby Trust Agreement.

There are two related items to mention. First, although the Standby Trust Agreement allows the Trustee to deduct its expenses from the trust fund, and allows for taxes to be paid from the trust fund, because the letter of credit was established in the amount of $561,000 without including such expense the U.S. EPA expects that Techalloy will pay all such expenses and taxes from its own funds. Second, the financial assurance for RCRA closure regulations -- which we are applying to corrective action financial assurance -- provide that a facility owner/operator annually reassess the cost estimate for inflation within 60 days prior to the anniversary date of the relevant financial instrument (40 CFR 265.142(b)). It is appropriate for Techalloy to do the same here, with respect to the cost estimate for the remaining corrective action work. Please let me know if this poses any problem.

Finally, in the past I have asked for copies of relevant documents as to Central Wire's acquisition of Techalloy. Could you send those to me now?

If you or your client have any questions, please telephone me at 312/886-7167, or e-mail me at miller.jacqueline@epa.gov.

Sincerely,

Jacqueline Miller
Associate Regional Counsel

Enclosures

cc: B. Sundar, EPA (w/o enclosures)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

REPLY TO THE ATTENTION OF

October 5, 2005

Jack Thorsen
Matrix Environmental
1880 W. Winchester Rd.
Suite 111
Libertyville, Illinois 60048

Re: Techalloy Company facility in Union, Illinois

Dear Mr. Thorsen:

At your request I am enclosing copies of materials concerning all modifications to the Administrative Order on Consent, No. R8H-5-99-008, entered into by Techalloy Company, Inc., and U.S. EPA since the date the Order was signed and became effective on September 30, 1999. The letters dated September 27, 2004, and November 23, 2004, concern Techalloy Company's request for a reduction in financial assurance for the work, from the $3 million referenced in the Order to $561,000. The U.S. EPA approved that request in our November 23, 2004, letter. I have been working with Techalloy Company's attorney to develop a modification to the Order recognizing this reduced financial assurance; I expect that modification will be executed within a month.

If you have any further questions, you may telephone me at 312/886-7167, or the U.S. EPA technical assignee for this matter, Bhooma Sundar, whose telephone number is 312/886-1660.

Sincerely,

Jacqueline Miller
Associate Regional Counsel

Enclosures

cc: Bhooma Sundar (w/o enclosures)

STANDBY TRUST AGREEMENT

GRANTOR	TRUSTEE
Owner/Operator Name Techalloy Company, Inc.	Trustee Name Wells Fargo Bank, N.A.
Address 6509 Olson Road Union, Illinois 60180	Address
A Pennsylvania corporation	A National Bank

This Standby Trust Agreement, the "Agreement", is entered into as of October ___, 2005 by and between Techalloy Company, Inc., a Pennsylvania corporation, the "Grantor," and Wells Fargo Bank, N.A., a national bank, the "Trustee".

Whereas, the United States Environmental Protection Agency, "EPA," an agency of the United States Government, and the Grantor entered into an Administrative Order on Consent ("the Order"), EPA Docket No. R8H-5-99-008, with an effective date of September 30, 1999, (a copy of which is Attachment 1) which required that the Grantor implement certain corrective measures at the Techalloy Company, Inc., facility located in Union, Illinois,

Whereas, effective _____, 2005, the EPA and the Grantor mutually agreed to a Modification of Administrative Order on Consent ("the Modification", a copy of which is Attachment 2), which modified Section XII, Financial Responsibility, of the Order,

Whereas, the Modification provides, at amended Paragraph XII.A, that the Grantor is providing financial assurance in the amount of five-hundred and sixty-one thousand dollars ($561,000.00) for the future costs of implementing, operating, and maintaining the corrective measures selected in the Order,

Whereas, the Grantor has elected to secure an irrevocable standby letter of credit to provide all of such financial assurance for the future implementation of the corrective measures selected in the Order,

Whereas, the irrevocable standby letter of credit obtained by the Grantor was issued by the Bank of Nova Scotia on February 8, 2005, is in the amount of five-hundred and sixty-one thousand dollars ($561,000.00), provides that it shall expire on February 7, 2006, but may be automatically extended for a period of one year, provides that the EPA may draw upon it under certain conditions, and bears No. S40006/219856,

Whereas, the Grantor also has elected to establish this Standby Trust Agreement, which will be funded by the irrevocable standby letter of credit, No. S40006/219856, if the EPA draws upon the letter of credit,

Whereas, the Grantor, acting through its duly authorized officers, has selected the Trustee to be the trustee under this agreement, and the Trustee is willing to act as trustee,

Now, Therefore, the Grantor and the Trustee agree as follows:

Section 1. Definitions. As used in this Agreement:

(a) The term "Grantor" means the Techalloy Company, Inc., which is the owner and operator of the Techalloy Company facility located in Union, Illinois, who enters into this Agreement, and any successors or assigns of the Grantor.

(b) The term "Trustee" means the Trustee who enters into this Agreement and any successor Trustee.

Section 2. Identification of Facilities and Cost Estimates. This Agreement pertains to the facility and cost estimate identified on attached Schedule A.

Section 3.1. Standby Trust. This Trust shall remain dormant until funded with the proceeds from the irrevocable standby letter of credit identified above. During the dormancy of this Trust, the Trustee shall have no duties or responsibilities beyond the safekeeping of this Agreement. Upon funding, this Trust shall become active and be administered pursuant to the terms of this Agreement.

Section 3.2. Establishment of Fund. The Grantor and the Trustee hereby establish a trust fund, the "Fund," for the benefit of EPA. The Grantor and the Trustee intend that no third party have access to the Fund except as herein provided. The Fund is established initially as consisting of the property, which is acceptable to the Trustee, described in Schedule B attached hereto. Such property and any other property subsequently transferred to the Trustee is referred to as the Fund, together with all earnings and profits thereon, less any payments or distributions made by the Trustee pursuant to this Agreement. The Fund shall be held by the Trustee, IN TRUST, as hereinafter provided. The Trustee shall not be responsible nor shall it undertake any responsibility for the amount or adequacy of, nor any duty to collect from the Grantor, any payments necessary to discharge any liabilities of the Grantor established by EPA.

Section 4. Payment for Corrective Measures. The Trustee shall make payments from the Fund as the EPA Regional Administrator of Region 5 shall direct, in writing, to provide for the payment of the costs of future implementation of corrective measures at the facility covered by this Agreement, as required by the Order and any modifications of the Order; such costs may include, but are not limited to, the operation and maintenance costs of installed and constructed elements of the corrective measures. The Trustee shall reimburse the Grantor or other persons as specified by the EPA Regional Administrator from the Fund in such amounts as the EPA Regional Administrator shall direct in writing. In addition, the Trustee shall refund to the Grantor such amounts as the EPA Regional Administrator specifies in writing. Upon refund, such funds shall no longer constitute part of the Fund as defined herein.

Section 5. Payments Comprising the Fund. Payments made to the Trustee for the Fund, by the provider of financial assurance pursuant to the EPA Regional Administrator's instructions, shall consist of cash or securities acceptable to the Trustee.

Section 6. Trustee Management. At such time as the corpus of the Trust is funded, the Trustee shall invest and reinvest the principal and income of the Fund and keep the Fund invested as a single fund, without distinction between principal and income, in accordance with general investment policies and guidelines which the Grantor may communicate in writing to the

Trustee from time to time, subject, however, to the provisions of this section. In investing, reinvesting, exchanging, selling, and managing the Fund, the Trustee shall discharge his duties with respect to the trust fund solely in the interest of the beneficiary and with the care, skill, prudence, and diligence under the circumstances then prevailing which persons of prudence, acting in a like capacity and familiar with such matters, would use in the conduct of an enterprise of a like character and with like aims; *except that:*

(i) Securities or other obligations of the Grantor, or any other owner or operator of the facility, or any of their affiliates as defined in the Investment Company Act of 1940, as amended, 15 U.S.C. 80a–2.(a), shall not be acquired or held, unless they are securities or other obligations of the Federal or a State government;

(ii) The Trustee is authorized to invest the Fund in time or demand deposits of the Trustee, to the extent insured by an agency of the Federal or State government; and

(iii) The Trustee is authorized to hold cash awaiting investment or distribution uninvested for a reasonable time, but not to exceed thirty (30) days, without liability for the payment of interest thereon.

Section 7. Commingling and Investment. The Trustee is expressly authorized in its discretion:

(a) To transfer from time to time any or all of the assets of the Fund to any common, commingled, or collective trust fund created by the Trustee in which the Fund is eligible to participate, subject to all of the provisions thereof, to be commingled with the assets of other trusts participating therein; and

(b) To purchase shares in any investment company registered under the Investment Company Act of 1940, 15 U.S.C. 80a–1, et seq., including one which may be created, managed, underwritten, or to which investment advice is rendered or the shares of which are sold by the Trustee. The Trustee may vote such shares in its discretion.

Section 8. Express Powers of Trustee. Without in any way limiting the powers and discretions conferred upon the Trustee by the other provisions of this Agreement or by law, the Trustee is expressly authorized and empowered:

(a) To sell, exchange, convey, transfer, or otherwise dispose of any property held by it, by public or private sale. No person dealing with the Trustee shall be bound to see to the application of the purchase money or to inquire into the validity or expediency of any such sale or other disposition;

(b) To make, execute, acknowledge, and deliver any and all documents of transfer and conveyance and any and all other instruments that may be necessary or appropriate to carry out the powers herein granted;

(c) To register any securities held in the Fund in its own name or in the name of a nominee and to hold any security in bearer form or in book entry, or to combine certificates representing such securities with certificates of the same issue held by the

Trustee in other fiduciary capacities, or to deposit or arrange for the deposit of such securities in a qualified central depositary even though, when so deposited, such securities may be merged and held in bulk in the name of the nominee of such depositary with other securities deposited therein by another person, or to deposit or arrange for the deposit of any securities issued by the United States Government, or any agency or instrumentality thereof, with a Federal Reserve bank, but the books and records of the Trustee shall at all times show that all such securities are part of the Fund;

(d) To deposit any cash in the Fund in interest-bearing accounts maintained or savings certificates issued by the Trustee, in its separate corporate capacity, or in any other banking institution affiliated with the Trustee, to the extent insured by an agency of the Federal or State government; and

(e) To compromise or otherwise adjust all claims in favor of or against the Fund.

Section 9. ***Taxes and Expenses.*** All taxes of any kind that may be assessed or levied against or in respect of the Fund and all brokerage commissions incurred by the Fund shall be paid from the Fund. All other expenses incurred by the Trustee in connection with the administration of this Trust, including fees for legal services rendered to the Trustee, the compensation of the Trustee to the extent not paid directly by the Grantor, and all other proper charges and disbursements of the Trustee shall be paid from the Fund.

Section 10. ***Annual Valuation.*** The Trustee shall annually, at least 30 days prior to the anniversary date of establishment of the Fund, furnish to the Grantor and to the EPA Regional Administrator of Region 5 a statement confirming the value of the Trust. Any securities in the Fund shall be valued at market value as of no more than 60 days prior to the anniversary date of establishment of the Fund. The failure of the Grantor to object in writing to the Trustee within 90 days after the statement has been furnished to the Grantor and the EPA Regional Administrator shall constitute a conclusively binding assent by the Grantor, barring the Grantor from asserting any claim or liability against the Trustee with respect to matters disclosed in the statement.

Section 11. ***Advice of Counsel.*** The Trustee may from time to time consult with counsel, who may be counsel to the Grantor, with respect to any question arising as to the construction of this Agreement or any action to be taken hereunder. The Trustee shall be fully protected, to the extent permitted by law, in acting upon the advice of counsel.

Section 12. ***Trustee Compensation.*** The Trustee shall be entitled to reasonable compensation for its services as agreed upon in writing from time to time with the Grantor.

Section 13. ***Successor Trustee.*** The Trustee may resign or the Grantor may replace the Trustee, but such resignation or replacement shall not be effective until the Grantor has appointed a successor trustee and this successor accepts the appointment. The successor trustee shall have the same powers and duties as those conferred upon the Trustee hereunder. Upon the successor trustee's acceptance of the appointment, the Trustee shall assign, transfer, and pay over to the successor trustee the funds and properties then constituting the Fund. If for any reason the Grantor cannot or does not act in the event of the resignation of the Trustee, the Trustee may apply to a court of competent jurisdiction for the appointment of a successor trustee or for instructions. The successor trustee shall specify the date on which it assumes administration of the trust in a writing sent to the Grantor, the EPA Regional Administrator, and the present Trustee by certified mail 10 days before such change becomes effective. Any expenses incurred by the Trustee as a result of any of the acts contemplated by this Section shall be paid as provided in Section 9.

Section 14. Instructions to the Trustee. All orders, requests, and instructions by the Grantor to the Trustee shall be in writing, signed by such persons as are designated in the attached Exhibit A or such other designees as the Grantor may designate by amendment to Exhibit A. The Trustee shall be fully protected in acting without inquiry in accordance with the Grantor's orders, requests, and instructions. All orders, requests, and instructions by the EPA Regional Administrator to the Trustee shall be in writing, signed by the EPA Regional Administrator of Region 5, or his designee, and the Trustee shall act and shall be fully protected in acting in accordance with such orders, requests, and instructions. The Trustee shall have the right to assume, in the absence of written notice to the contrary, that no event constituting a change or a termination of the authority of any person to act on behalf of the Grantor or EPA hereunder has occurred. The Trustee shall have no duty to act in the absence of such orders, requests, and instructions from the Grantor and/or EPA, except as provided for herein.

Section 15. Amendment of Agreement. This Agreement may be amended by an instrument in writing executed by the Grantor, the Trustee, and the EPA Regional Administrator of Region 5, or by the Trustee and the EPA Regional Administrator of Region 5 if the Grantor ceases to exist.

Section 16. Irrevocability and Termination. Subject to the right of the parties to amend this Agreement as provided in Section 15, this Trust shall be irrevocable and shall continue until terminated at the written agreement of the Grantor, the Trustee, and the EPA Regional Administrator of Region 5, or by the Trustee and the EPA Regional Administrator of Region 5 if the Grantor ceases to exist. Upon termination of the Trust, all remaining trust property, less final trust administration expenses, shall be delivered to the Grantor.

Section 17. Immunity and Indemnification. The Trustee shall not incur personal liability of any nature in connection with any act or omission, made in good faith, in the administration of this Trust, or in carrying out any directions by the Grantor or the EPA Regional Administrator of Region 5 that are issued in accordance with this Agreement. The Trustee shall be indemnified and saved harmless by the Grantor or from the Trust Fund, or both, from and against any personal liability to which the Trustee may be subjected by reason of any act or conduct in its official capacity, including all expenses reasonably incurred in its defense in the event the Grantor fails to provide such defense.

Section 18. Choice of Law. This Agreement shall be administered, construed, and enforced according to the laws of the State of Illinois.

Section 19. Interpretation. As used in this Agreement, words in the singular include the plural and words in the plural include the singular. The descriptive headings for each Section of this Agreement shall not affect the interpretation or the legal efficacy of this Agreement.

IN WITNESS WHEREOF the parties have caused this Agreement to be executed by their respective officers duly authorized and their corporate seals to be hereunto affixed and attested as of the date first above written:

Signature of Grantor	Title President
Typed or Printed Name of Person Signing Lawrence L. Smith Attest: Title	Seal
Signature of Trustee	Title
Typed or Printed Name of Person Signing Attest: Title	Seal

SCHEDULE A

Facility:

Techalloy Company, Inc.
6509 Olson Road
Union, Illinois 60180

EPA I.D. No.:

ILD 005 178 975

Corrective Measures Implementation Cost Estimate

Five Hundred Sixty-One Thousand Dollars ($561,000.00) as of September 2004.

STANDBY TRUST AGREEMENT

SCHEDULE B

List of Property Comprising Trust Fund

None at the time of the trust establishment. Funding of this Standby Trust Agreement is contingent upon drafts against that primary Irrevocable Standby Letter of Credit S40006/219856
Surety Bond or Letter of Credit Number

and issued by the Bank of Nova Scotia
Issuing Institution

on February 8, 2005 in accordance with the terms of that Letter of Credit.
Date Surety Bond or Letter of Credit

Non-responsive

[redacted]

TECHALLOY Company, Inc.
Arcelor Group

February 8, 2005

USEPA Region 5
Ms. Jacqueline Miller
Associate Regional Counsel
77 West Jackson Boulevard
Chicago, IL 60604-3590

Re: RCRA Section 3008(h) Administrative Order on Consent for Corrective Measures Implementation — Techalloy Company, Inc., ILD 005178975 — Substitution of Financial Mechanism

Dear Ms. Miller:

Regarding the referenced financial assurance, we would like to inform you that the stock of Techalloy Company, Inc. was recently sold pursuant a Purchase Agreement dated February 8, 2005. To date, Techalloy has provided financial assurances for corrective action at its Union, IL facility in the form of a corporate guarantee from Ugine-Savoie Imphy, Techalloy's former parent, in the amount of $3 million (the amount specified in the Section 3008(h) Order). Due to Techalloy's completion of corrective measures implementation, EPA recently agreed that financial assurances may be reduced to $561,000, consistent with future operation and maintenance costs. Please refer to the letter of November 23, 2004 from Ms. Bhooma Sundar to Scott Carr, Techalloy's Environmental Coordinator for the Union Facility.

In accordance with the Purchase Agreement, Techalloy agreed to substitute the existing corporate guarantee from Ugine-Savoie Imphy with an alternate financial mechanism acceptable to EPA. An irrevocable standby letter of credit, copy enclosed, has been selected for this purpose. The purchaser (Techalloy's new parent) is under certain contractual obligations to the seller (Techalloy's former parent) relating to the subject of financial assurances. Accordingly, we would appreciate your review and approval of this documentation at your earliest opportunity. The existing corporate guarantee from Ugine-Savoie Imphy will be terminated once we receive notice of EPA's approval of the letter of credit and the Consent Order is modified.

370 Franklin Turnpike • Mahwah, NJ 07430
Phone: 201.529.0900 • Fax: 201.529.1074
www.techalloy.com

We also understand that it will be necessary to modify the Consent Order to reflect the EPA-approved reduction in the amount of financial assurance we are required to maintain. We will pursue this issue with you in separate correspondence in the near future.

Thank you for your cooperation in this regard. If you need additional information please feel free to contact me at (201) 529-0900 ext. 114. I look forward to hearing from you at your earliest convenience.

Sincerely,

Henry Lopes
Vice President Operations

copy: Margaret Rosegay, Pillsbury Winthrop
Bhooma Sundar, USEPA
David E. Novitski, Thelen Reid & Priest LLP

New England Region • 370 Franklin Turnpike • Mahwah, NJ 07430 USA
Local Phone: 201.529.5800 • Toll Free Phone: 800.528.5801 • Fax: 201.529.5698
www.uginestainless.com

Matrix Environmental, Inc.
357 Milwaukee Ave. Suite A
Libertyville, Illinois 60048
Phone: 847-367-6835
Fax: 847-367-6845

2 September 2004

Ms. Bhooma Sundar
U.S. Environmental Protection Agency
Region V
RCRA Enforcement and Compliance Assurance Branch (DE-9J)
77 West Jackson Boulevard
Chicago, Illinois 60604

Re: Techalloy Corrective Action Financial Assurance Cost Estimate
Union, Illinois Facility

Dear Ms. Sundar:

The Techalloy Company (Techalloy) requests that the U.S. Environmental Protection Agency (U.S. EPA) grant a revised Corrective Action Financial Assurance Cost Estimate for the Techalloy facility (ILD 005-178-975) located in Union, Illinois. Techalloy has completed the Corrective Action Implementation pursuant to RCRA Section 3008(h) Administrative Order on Consent dated 6 October 1999 and modification to the Order dated September 2001.

Corrective Measures Implementation required that Techalloy provide financial assurance for the implementation and operation and maintenance of the remediation systems. Techalloy has provided this financial assurance; however at this time Techalloy has completed the implementation phase of this Order. Therefore, Techalloy requests a revision to the financial assurance pertinent to only operation and maintenance of the remediation systems.

The enclosed table presents the remaining operation and maintenance activities and the projected cost. There are three remediation systems that require continued operation and maintenance: 1) air sparging/soil vapor extraction, 2) asphalt cap, and 3) groundwater extraction. It is estimated that based on current performance of the air sparging and soil vapor extraction systems that operation and maintenance activities will continue for three years. In accordance with the U.S. EPA Statement of Basis the asphalt cap will require a 30-year operation and maintenance. The cap has been in place for approximately three years, so financial assurance is estimated for a remaining 27 years. The final remediation system requiring operation and maintenance is the groundwater extraction system. This system has been operating since 1996 and based on observed decreasing concentrations and the fact that the on-site source area is being remediated, a remaining 14 years of operation and maintenance is projected. This is an estimate and revised estimates will be made in the future based on future analytical results.

Matrix Environmental, Inc.

If you have any comments or questions regarding the progress of this project, please do not hesitate to call me at (847) 367-6835.

Sincerely,

Carlos J. Serna, P.G.
Matrix Environmental, Inc.

CJS:sk

Attachment

cc: David Williams, Techalloy
Henry Lopes, Techalloy
Scott Carr, Techalloy

2003 Environmental Cost Estimate
Techalloy Company, Inc.
Union, Illinois

Union IL - 2004 Environmental Financial Assurance Cost Estimate					
Task	Operation and Maintenance Task	2004 Cost	Capital	Number of Years	Total Expense
1	Asphalt Cap	$ 10,000	$ -	28	$ 280,000
2	SVE and Sparging Systems	$ 10,000	$ 2,000	3	$ 36,000
3	Groundwater Extraction system	$ 15,000	$ 2,500	14	$ 245,000
	TOTAL	$ 35,000	$ 4,500	--	$ 561,000

P. 4

Matrix Environmental, Inc.

CONFIDENTIAL

TECHALLOY COMPANY, INC.

Techalloy Company, Inc.
Olson and Jefferson Roads
Union, Illinois

Streamlined Risk Evaluation (SRE)

September 2003

Prepared for:

Techalloy Company, Inc.
370 Franklin Turnpike
Mahwah, New Jersey 07430

Prepared by:

Matrix Environmental, Inc.
357 North Milwaukee Avenue, Suite A
Libertyville, Illinois 60048

Bhooma Sundar
03/25/04 10:49 AM

To: scarr@techalloy.com

cc: carlos@matrixenviro.com
cc:
Subject: O&M issues related to Techalloy

Mr. Scott Carr
Environmental Coordinator
Techalloy Company, Inc
6509 Olson Road. P.O. Box 423
Union, IL 60180-0423

Scott,

I would like to know your availability and also Carlo's for a conference call to discuss the following issues:

1. Discussion of December 2003 sampling results with respect to fluctuations in the concentration of tetrachloroethylene(PCE) in highbridge monitoring well.
2. Exceedance of PCE in the highbridge monitoring well at a level of 130 ppb which is well above the 11 ppb screening criteria with respect to indoor vapor intrusion.
3. Possibility of including more wells for sampling in the next round of sampling. For eg., including CW-1D, CW-1S (to check if plume migration is contained) and one time sampling near the water table around the residences that are above the plume and exceed the screening criteria for PCE.
4. Providing documentation in the monthly reports, the resurfacing activities on the asphalt cap as and when the work is completed.
5. Discussion of risk associated with construction worker scenario and a residential indoor vapor intrusion with the development of Lechner's Propety located at the west of union and north of O' Cock road.

Bhooma Sundar
Toxicologist
RCRA Corrective Action
Enforcement and Compliance Assurance Branch
Waste, Pesticides and Toxics Division
USEPA Region 5
312-886-1660

Matrix Environmental, Inc.
355 North Milwaukee Avenue, Suite A
Libertyville, Illinois 600480
Phone: 847-367-6835
Fax: 847-367-6845

Ms. Pamela Molitor
U.S. Environmental Protection Agency
Region V
RCRA Enforcement and Compliance Assurance Branch (DE-9J)
77 West Jackson Boulevard
Chicago, Illinois 60604

10 April 2002

Re: Techalloy Site Progress Report for March 2002

Dear Ms. Molitor:

Enclosed please find the Monthly Progress Report for the Techalloy Company located in Union, Illinois for the month of March 2002. Also, enclosed are the effluent analytical results for this month.

If you have any comments or questions regarding the progress of this project, please do not hesitate to call me at (847) 548-8236.

Very truly yours,
Matrix Environmental, Inc.

Carlos J. Serna, P.G.

CJS:

Attachment

cc: David Williams, Techalloy
Henry Lopes, Techalloy
Scott Carr, Techalloy
Steve Hughes, Techalloy
Kevin Lesko, IEPA

Jacqueline Miller

03/10/04 04:05 PM

To: Bhooma Sundar/R5/USEPA/US@EPA
cc:
Subject: Fw: Techalloy

Hi, I am the attorney assigned to this matter. Though I've had no involvement since early 2002 when Techalloy was asking for some extra time to install the asphalt cap.

Today I received a call from a developer who is interested in some property that is North of O'Cock Road and East of Union Road. She wanted info. regarding the Techalloy site and how it might impact development of this piece of property. Looking at a map I have, it looks like there may be a pump/treat well in the vicinity of this piece of property.

Would you be able to update me on what is going on regarding CM implementation at the site, refresh my memory on where monitoring well and pump/treat wells are (and any other related off-site wells), and refresh my memory on where the GW plume has been detected (I can't recall if we know that it is off-site). Any documents, including maps, you could pull together for me to forward on to this person would also be a great help.

FYI, I work on Tuesdays, Wednesday, and Fridays. Thanks for the assistance.

----- Forwarded by Jacqueline Miller/R5/USEPA/US on 03/10/2004 04:01 PM -----

Allen Wojtas

03/10/2004 03:43 PM

To: Jacqueline Miller/R5/USEPA/US
cc:
Subject: Re: Techalloy

Hi Jacqueline: New last name, but I think it's the former Jacqueline Kline. Advise me if I am wrong! Anyway, Bhooma Sundar is now assigned Techalloy. If I remember correctly, there are several documents showing the location of the wells including the recent (relatively speaking) Statement of Basis and Response to Comment. Bhooma should be able to locate the files for you. If you need me, let me know Allen

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SECTION 1

INTRODUCTION

This document presents a streamlined risk evaluation (SRE) conducted for the Techalloy Company, Inc. (Techalloy) located in Union, Illinois. The SRE was conducted to provide risk managers with a basis for evaluating whether action is warranted to mitigate potential health effects from the indoor vapor intrusion pathway. The U.S. Environmental Protection Agency (EPA) has requested that Techalloy assess the potential indoor vapor pathway.

Techalloy has completed a RCRA Facility Investigation (RFI), Corrective Measures Study (CMS), and Corrective Measures Implementation (CMI). The RFI was conducted to assess the soil and groundwater impacts associated with historical solid waste management units (SWMUS) located north of the manufacturing buildings. The sources of volatile organic compound (VOC) contamination to groundwater were the concrete evaporation pad and acid ponds. The sand and gravel aquifer is impacted from a depth of approximately 8 to10 feet below the ground surface (bgs) and extents to approximately 30 to 60 bgs.

The CMI included the installation of a soil vapor extraction system, groundwater air sparging system, and asphalt cap. These systems are currently operating to remediate the VOC groundwater plume, VOCs in the soil in the unsaturated zone, as well as immobilize metals by preventing infiltration of precipitation and surface water.

The document is organized according to the five basic steps of a risk assessment (EPA 1989), listed below:

- Data Evaluation and Selection of Constituents of Potential Concern (COPCs). The first step in a risk assessment consists of reviewing and evaluating available data and identifying COPCs in the environmental media at the site.

- Exposure Assessment. An exposure assessment involves an analysis of potentially exposed human receptors, selection of appropriate intake assumptions, estimation of exposure point concentrations (EPCs), and estimation of chemical daily intakes.

- Toxicity Assessment. The toxicity assessment involves a review of agency literature and the subsequent compilation of cancer slope factors (SFs) and reference doses (RfDs) that are used to estimate cancer risks and noncancer hazard quotients (HQs).

- Risk Characterization. The risk characterization combines the results of the previous three risk assessment steps to quantitatively characterize potential cancer risks and noncancer adverse health effects to human health associated with exposure to COPCs.

- Uncertainty Analysis. The uncertainty analysis provides a discussion of key factors that may result in an over- or underestimation of risk.

SECTION 2

STREAMLINE RISK EVALUATION

2.1 DATA EVALUATION AND SELECTION OF CONSTITUENTS OF POTENTIAL CONCERN

The groundwater plume containing chlorinated VOCs is sampled semi-annually to assess the ongoing remediation systems. Data used in this evaluation was collected during the most recent semi-annual groundwater sampling event (June 2003). Wells sampled in 2003 included: MW-2, MW-4, MW-5D, MW-5, MW-6, MW-7, MW-9, Techwell #1, and MW-100 (Figure 1). The wells were analyzed for VOCs using Method SW 8260B. Only six VOCs (i.e., 1,1-dichloroethene, 1,1-dichloroethane, 1,1,1-trichloroethane, trichloroethene, tetrachloroethene, and cis-1,2-dichloroethene) were detected in the groundwater. Sampling results are presented in Table 1.

Data from wells MW-2, MW-5D; MW-5; MW-6; MW-7, and MW-9 were not used in this evaluation since these wells are not near the Techalloy building, rather they are located over 400 feet downgradient of the Techalloy building. An inhabited building is generally considered **"near"** subsurface contaminants if it is located within approximately 100 ft laterally or vertically of known or interpolated soil gas or groundwater contaminants (EPA 2002). The shallow well closest to the Techalloy Building (TechWell #1) reported no detections of VOCs. The VOCs measured in MW-4 and MW-100 were used to evaluate the vapor intrusion pathway since these wells are closest to the Techalloy building and did detect concentrations of chlorinated VOCs. Monitoring well MW-4 is located approximately 100 feet northwest of the Techalloy Plant's hazardous waste storage area and MW-100 is located about 250 feet north of the plant. The center of the groundwater plume (i.e., maximum detected concentrations) is located about 800 feet northwest of the plant.

2.2 EXPOSURE ASSESSMENT

The exposure of commercial/industrial workers to volatile chemicals in groundwater within the Techalloy facility was evaluated using risk-based concentrations (RBCs) for subsurface vapor intrusion indoors. Risk-based concentrations for the inhalation of indoor vapors from groundwater exposure were calculated using the Johnson and Ettinger (1991) model and GW_SCREEN spreadsheets (EPA 2003) developed by the U.S. EPA (*User's Guide for the Johnson and Ettinger (1991) Model for Subsurface Vapor Intrusion into Buildings (Revised, December 2000).* The Johnson and Ettinger model incorporates both convective and diffusive mechanisms for estimating the transport of contaminant vapors emanating from groundwater and subsurface soils into indoor spaces located above the source of contamination. The Johnson and Ettinger model is a one-dimensional analytical solution to convective and diffusive vapor transport into indoor spaces and provides an estimated attenuation coefficient that relates the vapor concentration in the indoor space to the vapor concentration at the source of contamination. Inputs to the model include chemical properties of the contaminant, saturated and unsaturated zone properties, and structural properties of a building.

The GW_SCREEN model calculates risk-based groundwater concentrations given a user-defined risk level. The target risk levels input into the model were 1 x 10^{-6} for estimating cancer risks and a target HQ of 1 for estimating noncancer effects. The default and site-specific properties were input in to the model and are presented in Table 2, including a soil type and a 15 centimeter (cm) depth below grade to the bottom of enclosed space floor for commercial/industrial land use (i.e., assuming a slab foundation). Exposure parameters for a commercial/industrial receptor based on IEPA (2002) guidance (i.e., exposure frequency of 250 days/yr and exposure duration of 25 years) were also used in developing risk-based concentrations for the commercial/industrial land use scenario. The GW_SCREEN outputs represent acceptable exposure concentrations for assessing potential risks to commercial/industrial receptors. The GW_SCREEN model is available on-line at the U.S. EPA website http://www.epa.gov/superfund/programs/risk/airmodel/johnson_ettinger.htm. The GW_SCREEN outputs for the COPCs are presented in Appendix A

2.3 TOXICITY ASSESSMENT

The development of vapor intrusion risk-based concentrations using GW_SCREEN values incorporates the results of a toxicity analyses; therefore a separate toxicity assessment was not required. A complete list of all toxicity values used to develop the GW_SCREEN values is provided with each spreadsheet (EPA 2003) and is presented in Appendix B. For some carcinogens, separate risk-based values are available to assess their carcinogenic effects and their noncancer effects (EPA 2003b). For these compounds, both the cancer risks and potential for noncancer health effects were evaluated.

2.4 RISK CHARACTERIZATION

To evaluate the indoor vapor inhalation pathway, maximum detected concentrations of volatile chemicals in groundwater were compared to risk-based concentrations developed using the GW_SCREEN spreadsheets. Total cancer risk estimates and noncancer hazard quotients (HQs) were calculated for the maximum detected concentration of each volatile organic constituent detected in groundwater at monitoring well MW-4 and MW-100.

2.5 NONCANCER EFFECTS

Noncancer effects were estimated for each VOC in groundwater using the following proportion equation:

$$HQ_i = (EPC_i \times nRBC_i^{-1}) \times 1$$

where

HQ_i = Site related hazard quotient for chemical i (unitless)
EPC_i = Exposure Point Concentration for chemical i (ug/L)
$nRBC_i$ = Noncancer risk-based concentration (ug/L).
1 = Value of the RBC hazard quotient (the hazard quotient for all noncancer RBC is 1) (unitless).

A "total" noncancer estimate was calculated by summing the HQ_i values for detected VOCs. The resultant hazard index (HI) was then compared to a threshold value of 1 for adverse noncancer health effects.

2.6 CANCER RISKS

Cancer risks were estimated using the following equation:

$$CR_i = (EPC_i \times cRBC_i^{-1}) \times 10^{-6}$$

where:

CR_i	=	Site-related excess lifetime cancer risk for chemical i (unitless)
EPC_i	=	Exposure Point Concentration for chemical i (ug/L)
$cRBC_i$	=	Cancer-based risk-based concentration (ug/L)
10^{-6}	=	Value of the RBC cancer risk (the cancer risk associated with all cancer RBCs is 10^{-5}) (unitless)

A "total" cancer risk estimate was calculated by summing the CR_i values for detected VOCs. The resultant total cancer risk was then compared to a risk range of 10^{-6} to 10^{-4}.

SECTION 3

RESULTS AND CONCLUSIONS

3.1 RISK EVALUATION RESULTS

This section summarizes the SRE results for the Techalloy Plant. To aid in the interpretation of the results, the EPA states in the National Oil and Hazardous Substances Pollution Contingency Plan, that, "for known or suspected carcinogens, acceptable exposure levels are generally concentration levels that represent an excess upper bound lifetime cancer risk to an individual between 10^{-6} and 10^{-4}"(Title 40 of the *Code of Federal Regulations* Part 300.430). Discussions of risks in this SRE are based on 10^{-6} to 10^{-4} risk management range for adverse cancer effects. The EPA directive titled "Role of Baseline Risk Assessment in the Superfund Remedy Selection Decisions," states that where cumulative cancer risks to an individual based on the Reasonable Maximum Exposure (RME) for both current and future land use is less than 10^{-4} and no adverse noncancer effects exist, action generally is not warranted unless adverse environmental impacts exist (EPA 1991c). For evaluating noncarcinogens, a segregated noncancer HQ of one or less indicates that little or no potential exists for adverse health effects (EPA 1989).

Total cancer risk estimates and noncancer HQs were calculated for the maximum detected concentration of each volatile organic constituent detected in groundwater at monitoring wells MW-4 and MW-100presented in Table 3 and Table 4, respectively. For MW-4, the cancer risk estimates for trichloroethene is $2.8\text{-}10^{-5}$ and for tetrachloroethene is $1.2\text{-}10^{-5}$, a total risk estimate of 4×10^{-5}. For MW-100 a cancer risk estimate for tetrachloroethene is of 3×10^{-6}. The noncancer HQs are less then one unit at both wells. It should be noted that these wells are located downgradient of the Techalloy Plant building and that no VOCs were detected in wells located adjacent to the building (i.e., TechWell #1).

3.2 CONCLUSIONS

The results of this streamline risk assessment conclude that vapor accumulation at potential indoor structures located 100 feet to 250 feet northwest (downgradient) of the existing Techalloy buildings will not cause an adverse cancer or noncancer excess impact to commercial/industrial receptors. The incremental increase in cancer risk for suspected carcinogens are all within a manageable risk range (10^{-6} to 10^{-4}) and all the incremental increase in noncancer risk are less than one and considered within an expectable hazardous quotient. It is concluded that no adverse excess indoor vapor inhalation impact exists at the Techalloy plant. It is further emphasized that the areas inside the Techalloy buildings are located upgradient of the existing plume and shallow groundwater is not impacted with VOCs.

3.3 UNCERTAINTY AND SENSIVITY ANALYSIS

The goal of an uncertainty analysis in a risk assessment is to provide to the appropriate decision makers (i.e., risk managers) a wide range of information about the key assumptions, their inherent uncertainty and variability, and the impact of this uncertainty and variability on the estimates of risk. This subsection describes the key assumptions used in this risk assessment that present a significant level of uncertainty to the risk estimates.

- Indoor air concentrations of vapors were not measured. The Johnson and Ettinger model was used to evaluate the indoor air exposure pathway. This model consists of a groundwater and/or vadose zone source of volatile vapors that diffuse upwards through unsaturated soils towards the surface. Under the model, the soil in the vadose zone is considered to be relatively homogeneous and isotropic. The receptors at the surface used in the model are in buildings with poured concrete foundations (e.g., basement or slab on grade foundations or crawlspaces with a liner or other vapor barrier). The underlying assumption for this model is that site-specific subsurface characteristics will tend to reduce or attenuate vapor concentrations as vapors migrate upward from the source and into structures. Site-specific factors may result in unattenuated or enhanced transport of vapors towards a receptor. Thus, the risk associated with indoor air exposure may be over-or underestimated depending on whether the site-specific subsurface characteristics reflect model assumptions. Since default soil parameters for a sand soil type were used in the model runs, which are more conservative than the model default soil type of a sandy clay, the risk-based concentrations are expected to be overestimated.

- Vapor concentrations generally decrease with increasing distance from a subsurface vapor source, and eventually at some distance the concentrations become negligible. The distance at which concentrations are negligible is a function of the mobility, toxicity and persistence of the chemical, as well as the geometry of the source, subsurface materials, and characteristics of the buildings of concern. An inhabited building is generally considered **"near"** subsurface contaminants if it is located within approximately 100 ft laterally or vertically of known or interpolated soil gas or groundwater contaminants (EPA 2002) and the contamination occurs in the unsaturated zone and/or the uppermost saturated zone. The recommended lateral distance is supported by empirical data from Colorado sites where the vapor intrusion pathway has been evaluated. At these sites, no significant indoor air concentrations have been found in residences at a distance greater than one house lot (approximately 100 feet) from the interpolated edge of ground water plumes (EPA 2002). The highest VOC concentrations (except for 1,1-dichloroethene) were measured in monitoring wells located over 100 feet northwest (downgradient) of the Techalloy Plant. MW-4 is about 100 feet downgradient of the hazardous waste storage area and MW-100 is aobut 250 feet downgradient of the plant building. No VOCs were measured in wells directly adjacent to the plant building (TechWell #3). Thus, exposure and risk from the subsurface vapor intrusion pathway are expected to be overestimated since the contaminant plume is not near the plant building.

- The Johnson and Ettinger groundwater model assumes an infinite source of contamination. However, the source of groundwater contamination is downgradient of the building. In addition, the model does not account for transformation processes (e.g., biodegradation, hydrolysis, etc.). Thus, groundwater concentrations would be decreasing over time; thus, these model assumptions will overestimate the indoor inhalation risk.

Soil vapor permeability (k_v) and soil water-filled porosity (θw) are two of the most sensitive model parameters associated with convective transport of vapors within the zone of influence of the building. An increase in k_v results an increase in the building concentration while an increase in θw results in a decrease in building concentration (EPA 2000). Since site-specific data is lacking for these parameters, estimates of these values are made in the model based on the vadose zone soil type. A sandy soil was used to calculate the screening values used in this risk evaluation. However, the vadose zone soil type at the site varies, with a loamy topsoil layer present on the surface above the sand layer. Inputting a sandy loam soil type in the model results in risk-based concentrations of 1.73 ug/kg for TCE and 42.4 ug/kg for PCE, which are an order of magnitude higher than the risk-based concentrations for a sandy soil (0.193 ug/kg and 4.7 ug/kg, respectively). These risk-based concentrations for a sandy loam soil equate to a cancer risk of $4\text{-}10^{-7}$ at MW100 and $4\text{-}10^{-6}$ at MW-4 versus a cancer risk of $3\text{-}10^{-6}$ and $4\text{-}10^{-5}$, respectively. Thus, inputting a sandy soil type can overestimate the indoor inhalation risk by an order of magnitude. Data sheets for this sensitivity analysis are presented in Appendix C.

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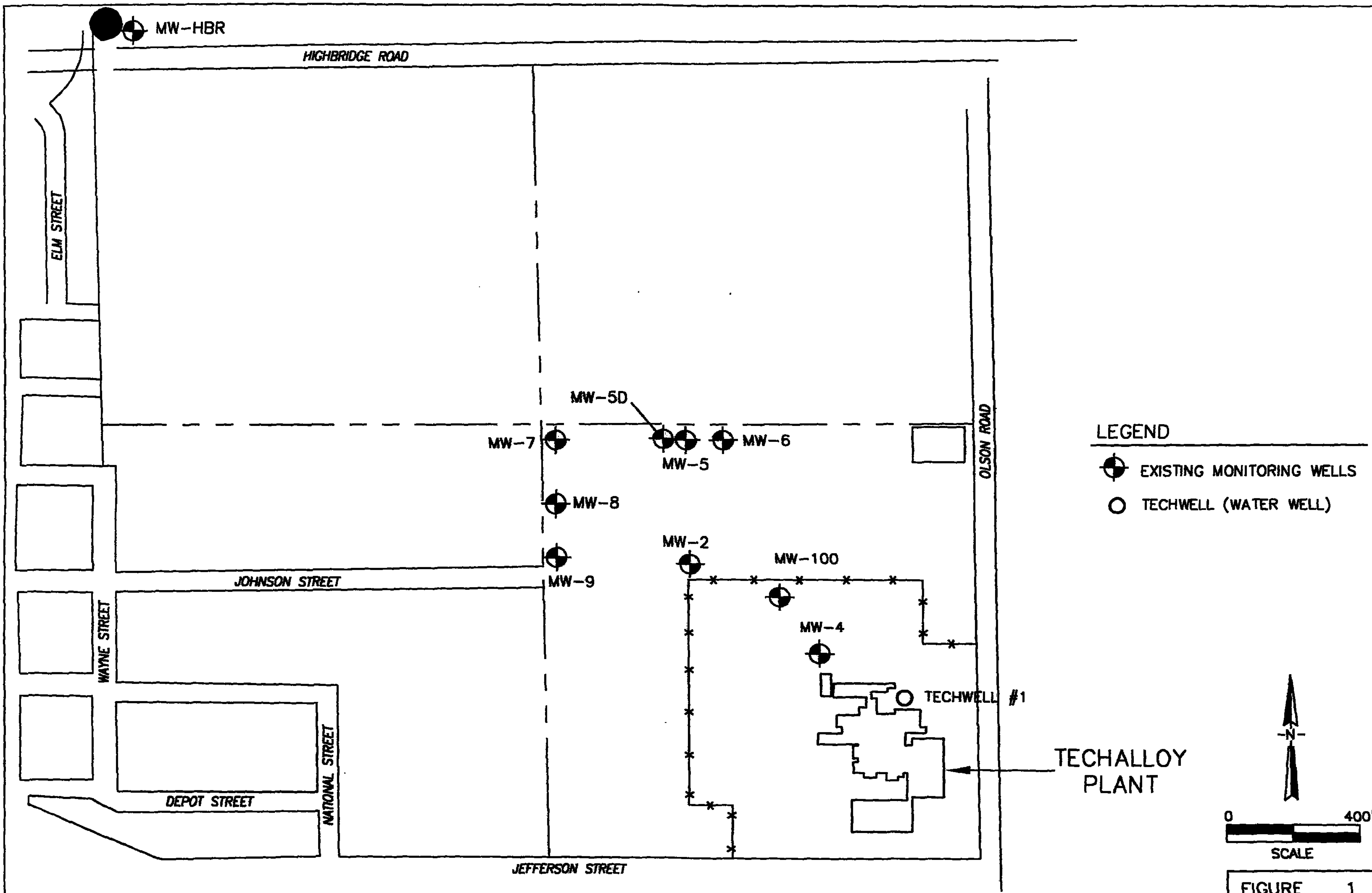


FIGURE 1

Matrix Environmental, Inc.
357 N. Milwaukee Ave., Suite A
Libertyville, IL 60048

MONITORING WELL LOCATIONS

TECHALLOY COMPANY, INC.
Union, Illinois

Table 1
2003 Monitoring Well Data
All Concentrations in ug/L

Compound	MW-9	MW-7	MW-5D	MW-5S	MW-6	MW-2	MW-4	TechWell #1	MW-100
1,1-Dichloroethene	1 U	11	1.3	5	1 U	1 U	1 U	2 U	2 U
1,1-Dichloroethane	1 U	10	2.4	5 U	1 U	20	21	1 U	1 U
1,1,1-Trichloroethane	1 U	840	50	360	1 U	88	59	1 U	5.55
Trichloroethene	1 U	63	63	10	1 U	9.5	5.4	1 U	1 U
Tetrachloroethene	1 U	140	1 U	190	10.5	39	55	1 U	15.7
cis-1,2-Dichloroethene	1 U	10 U	1 U	5 U	1 U	16	1 U	1 U	1 U

Wells sampled include MW-9;MW-7;MW-5D; MW-5S; MW-6; MW-2; and MW-4 (May 2003).
TechWell #1 and MW-100 (June 2003)

Table 2
Johnson and Ettinger Indoor Air Model - Tier 1 Input Parameters
Techalloy Property Evaluation

Parameter		Units	Default Value	Value Used in Tier 1 Evaluation	Comments
T	Average Soil/Groundwater Temperature	Celsius	10	9.8	site-specific; Lechner Property Evaluation
Lwt	Depth below grade to water table	cm	400	274	9 ft average depth to water table; RFI report
Lf	Depth below grade to bottom of enclosed floor space	cm	15 (slab)	15	site specific; slab foundation
K_v	Vadose zone SCS soil type or site-specific vapor permeability (cm2)	cm^2	1.00E-08	sand	site-specific; RFI Report
–	SCS Soil type directly above water table	–	sandy clay	sand	site-specific; RFI Report
Qsoil	Average vapor flow rate into building	L/m	5	calculated	leave blank for GW_SCREEN to calculate
BD_v	Vadose zone soil dry bulk density	g/cm^3	1.5	1.66	sand; GW_SCREEN
n_v	Vadose zone soil total porosity	unitless	0.43	0.375	sand; GW_SCREEN
Pw_v	Vadose zone water filled porosity	cm^3/cm^3	0.3	0.054	sand: GW_SCREEN
ATc	Averaging time - carcinogens	days	70 yrs x 365 days/yr	70 yrs x 365 days/yr	Commercial/Industrial; IEPA TACO
ATnc	Averaging time - noncarcinogens	days	30 yrs x 365 days/yr	25 yrs x 365 days/yr	Commercial/Industrial; IEPA TACO
ED	Exposure duration	years	30 yrs	25 yrs	Commercial/Industrial; IEPA TACO
EF	Exposure frequency	days/year	350	250	Commercial/Industrial; IEPA TACO
TR	Target risk - carcinogens	unitless	1.00E-06	1.00E-06	Commercial/Industrial; IEPA TACO
THQ	Target hazard quotient - noncarcinogens	unitless	1	1	Commercial/Industrial; IEPA TACO

Table 3

CANCER RISK AND HAZARD QUOTIENT EVALUATION:

SUBSURFACE VAPOR INTRUSION INTO BUILDINGS FROM ON-SITE GROUNDWATER (MW-100)

Commercial/Industrial Receptor

Techalloy, Union, Illinois

Chemical	Maximum Concentration (MW-100)	Units	GWSCREEN (1) Risk-based Concentration (ug/L)		Cancer Risk (unitless)	Hazard Quotient (unitless)
			Cancer	Noncancer		
VOCs						
1,1-Dichloroethene	ND	ug/L	--	4.43E+02	--	--
1,1-Dichloroethane	ND	ug/L	--	6.61E+03	--	--
1,1,1-Trichloroethane	6	ug/L	--	9.52E+03	--	5.8E-04
Trichloroethene	ND	ug/L	1.93E-01	3.04E+02	--	--
Tetrachloroethene	16	ug/L	4.70E+00	--	3.3E-06	--
cis-1,2-Dichloroethene	ND	ug/L	--	6.56E+02	--	--
					3E-06	--
					--	6E-04

(1) Risk-based soil concentration based on Johnson and Ettinger Model (U.S. EPA, 2003).

Ca - carcinogenic endpoint.

NC - noncarcinogenic endpoint.

Table 4
CANCER RISK AND HAZARD QUOTIENT EVALUATION:
SUBSURFACE VAPOR INTRUSION INTO BUILDINGS FROM ON-SITE GROUNDWATER (MW-4)
Commercial/Industrial Receptor
Techalloy, Union, Illinois

Chemical	Maximum Concentration (MW-4)	Units	GWSCREEN (1) Risk-based Concentration (ug/L)		Cancer Risk (unitless)	Hazard Quotient (unitless)
			Cancer	Noncancer		
VOCs						
1,1-Dichloroethene	ND	ug/L	--	4.43E+02	--	--
1,1-Dichloroethane	21	ug/L	--	6.61E+03	--	3.2E-03
1,1,1-Trichloroethane	59	ug/L	--	9.52E+03	--	6.2E-03
Trichloroethene	5.4	ug/L	1.93E-01	3.04E+02	2.8E-05	1.8E-02
Tetrachloroethene	55	ug/L	4.70E+00	--	1.2E-05	--
cis-1,2-Dichloroethene	ND	ug/L	--	6.56E+02	--	--
					4E-05	--
					--	3E-02

(1) Risk-based soil concentration based on Johnson and Ettinger Model (U.S. EPA, 2003).

Ca - carcinogenic endpoint.

NC - noncarcinogenic endpoint.

APPENDIX A

GW-SCREEN OUTPUT

APPENDIX B-2
VLOOKUP TABLES

Chemical Properties Lookup Table

CAS No.	Chemical	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Pure component water solubility, S (mg/L)	Henry's law constant H' (unitless)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	URF extrapolated (X)	RfC extrapolated (X)
56235	Carbon tetrachloride	1.74E+02	7.80E-02	8.80E-06	7.93E+02	1.24E+00	3.03E-02	25	349.90	556.60	7,127	1.5E-05	0.0E+00		
57749	Chlordane	1.20E+05	1.18E-02	4.37E-06	5.60E-02	1.99E-03	4.85E-05	25	624.24	885.73	14,000	1.0E-04	7.0E-04		
58899	gamma-HCH (Lindane)	1.07E+03	1.42E-02	7.34E-06	7.30E+00	5.73E-04	1.40E-05	25	596.55	839.36	15,000	3.7E-04	1.1E-03	X	X
60297	Ethyl ether	5.73E+00	7.82E-02	8.61E-06	5.68E+04	1.35E+00	3.29E-02	25	307.50	466.74	6,338	0.0E+00	7.0E-01		X
60571	Dieldrin	2.14E+04	1.25E-02	4.74E-06	1.95E-01	6.18E-04	1.51E-05	25	613.32	842.25	17,000	4.6E-03	1.8E-04		X
67641	Acetone	5.75E-01	1.24E-01	1.14E-05	1.00E+06	1.59E-03	3.87E-05	25	329.20	508.10	6,955	0.0E+00	3.5E-01		X
67663	Chloroform	3.98E+01	1.04E-01	1.00E-05	7.92E+03	1.50E-01	3.66E-03	25	334.32	536.40	6,988	2.3E-05	0.0E+00		
67721	Hexachloroethane	1.78E+03	2.50E-03	6.80E-06	5.00E+01	1.59E-01	3.88E-03	25	458.00	695.00	9,510	4.0E-06	3.5E-03		X
71432	Benzene	5.89E+01	8.80E-02	9.80E-06	1.79E+03	2.27E-01	5.54E-03	25	353.24	562.16	7,342	7.8E-06	0.0E+00		
71556	1,1,1-Trichloroethane	1.10E+02	7.80E-02	8.80E-06	1.33E+03	7.03E-01	1.72E-02	25	347.24	545.00	7,136	0.0E+00	2.2E+00		
72435	Methoxychlor	9.77E+04	1.56E-02	4.46E-06	1.00E-01	6.46E-04	1.58E-05	25	651.02	848.49	16,000	0.0E+00	1.8E-02		X
72559	DDE	4.47E+06	1.44E-02	5.87E-06	1.20E-01	8.59E-04	2.09E-05	25	636.44	860.38	15,000	9.7E-05	0.0E+00	X	
74839	Methyl bromide	1.05E+01	7.28E-02	1.21E-05	1.52E+04	2.55E-01	6.22E-03	25	276.71	467.00	5,714	0.0E+00	5.0E-03		
74873	Methyl chloride (chloromethane)	2.12E+00	1.26E-01	6.50E-06	5.33E+03	3.61E-01	8.80E-03	25	249.00	416.25	5,115	1.0E-06	9.0E-02		
74908	Hydrogen cyanide	3.80E+00	1.93E-01	2.10E-05	1.00E+06	5.44E-03	1.33E-04	25	299.00	456.70	6,676	0.0E+00	3.0E-03		
74953	Methylene bromide	1.26E+01	4.30E-02	8.44E-06	1.19E+04	3.52E-02	8.59E-04	25	370.00	583.00	7,868	0.0E+00	3.5E-02		X
75003	Chloroethane (ethyl chloride)	4.40E+00	2.71E-01	1.15E-05	5.68E+03	3.61E-01	8.80E-03	25	285.30	460.40	5,879	8.3E-07	1.0E+01	X	
75014	Vinyl chloride (chloroethene)	1.86E+01	1.06E-01	1.23E-05	8.80E+03	1.10E+00	2.69E-02	25	259.25	432.00	5,250	8.8E-06	1.0E-01		
75058	Acetonitrile	4.20E+00	1.28E-01	1.66E-05	1.00E+06	1.42E-03	3.45E-05	25	354.60	545.50	7,110	0.0E+00	6.0E-02		
75070	Acetaldehyde	1.06E+00	1.24E-01	1.41E-05	1.00E+06	3.23E-03	7.87E-05	25	293.10	466.00	6,157	2.2E-06	9.0E-03		
75092	Methylene chloride	1.17E+01	1.01E-01	1.17E-05	1.30E+04	8.96E-02	2.18E-03	25	313.00	510.00	6,706	4.7E-07	3.0E+00		
75150	Carbon disulfide	4.57E+01	1.04E-01	1.00E-05	1.19E+03	1.24E+00	3.02E-02	25	319.00	552.00	6,391	0.0E+00	7.0E-01		
75218	Ethylene oxide	1.33E+00	1.04E-01	1.45E-05	3.04E+05	2.27E-02	5.54E-04	25	283.60	469.00	6,104	1.0E-04	0.0E+00		
75252	Bromoform	8.71E+01	1.49E-02	1.03E-05	3.10E+03	2.41E-02	5.88E-04	25	422.35	696.00	9,479	1.1E-06	7.0E-02		X
75274	Bromodichloromethane	5.50E+01	2.98E-02	1.06E-05	6.74E+03	6.54E-02	1.60E-03	25	363.15	585.85	7,800	1.8E-05	7.0E-02	X	X
75296	2-Chloropropane	9.14E+00	8.88E-02	1.01E-05	3.73E+03	5.93E-01	1.45E-02	25	308.70	485.00	6,286	0.0E+00	1.0E-01		
75343	1,1-Dichloroethane	3.16E+01	7.42E-02	1.05E-05	5.06E+03	2.30E-01	5.61E-03	25	330.55	523.00	6,895	0.0E+00	5.0E-01		
75354	1,1-Dichloroethylene	5.89E+01	9.00E-02	1.04E-05	2.25E+03	1.07E+00	2.60E-02	25	304.75	576.05	6,247	0.0E+00	2.0E-01		
75456	Chlorodifluoromethane	4.79E+01	1.01E-01	1.28E-05	2.00E+00	1.10E+00	2.70E-02	25	232.40	369.30	4,836	0.0E+00	5.0E+01		
75694	Trichlorofluoromethane	4.97E+02	8.70E-02	9.70E-06	1.10E+03	3.97E+00	9.68E-02	25	296.70	471.00	5,999	0.0E+00	7.0E-01		
75718	Dichlorodifluoromethane	4.57E+02	6.65E-02	9.92E-06	2.80E+02	1.40E+01	3.42E-01	25	243.20	384.95	9,421	0.0E+00	2.0E-01		
76131	1,1,2-Trichloro-1,2,2-trifluoroethar	1.11E+04	7.80E-02	8.20E-06	1.70E+02	1.97E+01	4.80E-01	25	320.70	487.30	6,463	0.0E+00	3.0E+01		
76448	Heptachlor	1.41E+06	1.12E-02	5.69E-06	1.80E-01	6.05E+01	1.48E+00	25	603.69	846.31	13,000	1.3E-03	1.8E-03		X
77474	Hexachlorocyclopentadiene	2.00E+05	1.61E-02	7.21E-06	1.80E+00	1.10E+00	2.69E-02	25	512.15	746.00	10,931	0.0E+00	2.0E-04		
78831	Isobutanol	2.59E+00	8.60E-02	9.30E-06	8.50E+04	4.83E-04	1.18E-05	25	381.04	547.78	10,936	0.0E+00	1.1E+00		X
78875	1,2-Dichloropropane	4.37E+01	7.82E-02	8.73E-06	2.80E+03	1.15E-01	2.79E-03	25	369.52	572.00	7,590	1.9E-05	4.0E-03	X	
78933	Methylethylketone (2-butanone)	2.30E+00	8.08E-02	9.80E-06	2.23E+05	2.29E-03	5.58E-05	25	352.50	536.78	7,481	0.0E+00	1.0E+00		
79005	1,1,2-Trichloroethane	5.01E+01	7.80E-02	8.80E-06	4.42E+03	3.73E-02	9.11E-04	25	386.15	602.00	8,322	1.6E-05	1.4E-02		X
79016	Trichloroethylene	1.66E+02	7.90E-02	9.10E-06	1.47E+03	4.21E-01	1.03E-02	25	360.36	544.20	7,505	1.1E-04	4.0E-02	X	
79209	Methyl acetate	3.26E+00	1.04E-01	1.00E-05	2.00E+03	4.84E-03	1.18E-04	25	329.80	506.70	7,260	0.0E+00	3.5E+00		X
79345	1,1,2,2-Tetrachloroethane	9.33E+01	7.10E-02	7.90E-06	2.96E+03	1.41E-02	3.44E-04	25	419.60	661.15	8,996	5.8E-05	2.1E-01		X
79469	2-Nitropropane	1.17E+01	9.23E-02	1.01E-05	1.70E+04	5.03E-03	1.23E-04	25	393.20	594.00	8,383	2.7E-03	2.0E-02		
80626	Methylmethacrylate	6.98E+00	7.70E-02	8.60E-06	1.50E+04	1.38E-02	3.36E-04	25	373.50	567.00	8,975	0.0E+00	7.0E-01		
83329	Acenaphthene	7.08E+03	4.21E-02	7.69E-06	3.57E+00	6.34E-03	1.55E-04	25	550.54	803.15	12,155	0.0E+00	2.1E-01		X
86737	Fluorene	1.38E+04	3.63E-02	7.88E-06	1.98E+00	2.60E-03	6.34E-05	25	570.44	870.00	12,666	0.0E+00	1.4E-01		X
87683	Hexachloro-1,3-butadiene	5.37E+04	5.61E-02	6.16E-06	3.20E+00	3.33E-01	8.13E-03	25	486.15	738.00	10,206	2.2E-05	7.0E-04		X
88722	o-Nitrotoluene	3.24E+02	5.87E-02	8.67E-06	6.50E+02	5.11E-04	1.25E-05	25	495.00	720.00	12,239	0.0E+00	3.5E-02		X
91203	Naphthalene	2.00E+03	5.90E-02	7.50E-06	3.10E+01	1.98E-02	4.82E-04	25	491.14	748.40	10,373	0.0E+00	3.0E-03		
91576	2-Methylnaphthalene	2.81E+03	5.22E-02	7.75E-06	2.46E+01	2.12E-02	5.17E-04	25	514.26	761.00	12,600	0.0E+00	7.0E-02		X
92524	Biphenyl	4.38E+03	4.04E-02	8.15E-06	7.45E+00	1.23E-02	2.99E-04	25	529.10	789.00	10,890	0.0E+00	1.8E-01		X
95476	o-Xylene	3.63E+02	8.70E-02	1.00E-05	1.78E+02	2.12E-01	5.18E-03	25	417.60	630.30	8,661	0.0E+00	7.0E+00		X
95501	1,2-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	1.56E+02	7.77E-02	1.90E-03	25	453.57	705.00	9,700	0.0E+00	2.0E-01		
95578	2-Chlorophenol	3.88E+02	5.01E-02	9.46E-06	2.20E+04	1.60E-02	3.90E-04	25	447.53	675.00	9,572	0.0E+00	1.8E-02		X
95636	1,2,4-Trimethylbenzene	1.35E+03	6.06E-02	7.92E-06	5.70E+01	2.52E-01	6.14E-03	25	442.30	649.17	9,369	0.0E+00	6.0E-03		
96184	1,2,3-Trichloropropane	2.20E+01	7.10E-02	7.90E-06	1.75E+03	1.67E-02	4.08E-04	25	430.00	652.00	9,171	5.7E-04	4.9E-03	X	
96333	Methyl acrylate	4.53E+00	9.76E-02	1.02E-05	6.00E+04	7.68E-03	1.87E-04	25	353.70	536.00	7,749	0.0E+00	1.1E-01		X
97632	Ethylmethacrylate	2.95E+01	6.53E-02	8.37E-06	3.67E+03	3.44E-02	8.40E-04	25	390.00	571.00	10,957	0.0E+00	3.2E-01		X
98066	tert-Butylbenzene	7.71E+02	5.65E-02	8.02E-06	2.95E+01	4.87E-01	1.19E-02	25	442.10	1220.00	8,980	0.0E+00	1.4E-01		X
98828	Cumene	4.89E+02	6.50E-02	7.10E-06	6.13E+01	4.74E+01	1.16E+00	25	425.56	631.10	10,335	0.0E+00	4.0E-01		

Chemical Properties Lookup Table

CAS No.	Chemical	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Pure component water solubility, S (mg/L)	Henry's law constant H' (unitless)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	URF extrapolated (X)	RfC extrapolated (X)
98862	Acetophenone	5.77E+01	6.00E-02	8.73E-06	6.13E+03	4.38E-04	1.07E-05	25	475.00	709.50	11,732	0.0E+00	3.5E-01		X
98953	Nitrobenzene	6.46E+01	7.60E-02	8.60E-06	2.09E+03	9.82E-04	2.39E-05	25	483.95	719.00	10,566	0.0E+00	2.0E-03		
100414	Ethylbenzene	3.63E+02	7.50E-02	7.80E-06	1.69E+02	3.22E-01	7.86E-03	25	409.34	617.20	8,501	1.1E-06	1.0E+00		
100425	Styrene	7.76E+02	7.10E-02	8.00E-06	3.10E+02	1.12E-01	2.74E-03	25	418.31	636.00	8,737	0.0E+00	1.0E+00		
100447	Benzylchloride	6.14E+01	7.50E-02	7.80E-06	5.25E+02	1.70E-02	4.14E-04	25	452.00	685.00	8,773	4.9E-05	0.0E+00	X	
100527	Benzaldehyde	4.59E+01	7.21E-02	9.07E-06	3.30E+03	9.73E-04	2.37E-05	25	452.00	695.00	11,658	0.0E+00	3.5E-01		X
103651	n-Propylbenzene	5.62E+02	6.01E-02	7.83E-06	6.00E+01	4.37E-01	1.07E-02	25	432.20	630.00	9,123	0.0E+00	1.4E-01		X
104518	n-Butylbenzene	1.11E+03	5.70E-02	8.12E-06	2.00E+00	5.38E-01	1.31E-02	25	456.46	660.50	9,290	0.0E+00	1.4E-01		X
106423	p-Xylene	3.89E+02	7.69E-02	8.44E-06	1.85E+02	3.13E-01	7.64E-03	25	411.52	616.20	8,525	0.0E+00	7.0E+00		X
106467	1,4-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	7.90E+01	9.82E-02	2.39E-03	25	447.21	684.75	9,271	0.0E+00	8.0E-01		
106934	1,2-Dibromoethane (ethylene dibr	2.50E+01	2.17E-02	1.19E-05	4.18E+03	3.04E-02	7.41E-04	25	404.60	583.00	8,310	2.2E-04	2.0E-04		
106990	1,3-Butadiene	1.91E+01	2.49E-01	1.08E-05	7.35E+02	3.01E+00	7.34E-02	25	268.60	425.00	5,370	2.8E-04	0.0E+00		
107028	Acrolein	2.76E+00	1.05E-01	1.22E-05	2.13E+05	4.99E-03	1.22E-04	25	325.60	506.00	6,731	0.0E+00	2.0E-05		
107062	1,2-Dichloroethane	1.74E+01	1.04E-01	9.90E-06	8.52E+03	4.00E-02	9.77E-04	25	356.65	561.00	7,643	2.6E-05	0.0E+00		
107131	Acrylonitrile	5.90E+00	1.22E-01	1.34E-05	7.40E+04	4.21E-03	1.03E-04	25	350.30	519.00	7,786	6.8E-05	2.0E-03		
108054	Vinyl acetate	5.25E+00	8.50E-02	9.20E-06	2.00E+04	2.09E-02	5.10E-04	25	345.65	519.13	7,800	0.0E+00	2.0E-01		
108101	Methylisobutylketone (4-methyl-2-	9.06E+00	7.50E-02	7.80E-06	1.90E+04	5.64E-03	1.38E-04	25	389.50	571.00	8,243	0.0E+00	8.0E-02		
108383	m-Xylene	4.07E+02	7.00E-02	7.80E-06	1.61E+02	3.00E-01	7.32E-03	25	412.27	617.05	8,523	0.0E+00	7.0E+00		X
108678	1,3,5-Trimethylbenzene	1.35E+03	6.02E-02	8.67E-06	2.00E+00	2.41E-01	5.87E-03	25	437.89	637.25	9,321	0.0E+00	6.0E-03		
108872	Methylcyclohexane	7.85E+01	7.35E-02	8.52E-06	1.40E+01	4.22E+00	1.03E-01	25	373.90	572.20	7,474	0.0E+00	3.0E+00		
108883	Toluene	1.82E+02	8.70E-02	8.60E-06	5.26E+02	2.72E-01	6.62E-03	25	383.78	591.79	7,930	0.0E+00	4.0E-01		
108907	Chlorobenzene	2.19E+02	7.30E-02	8.70E-06	4.72E+02	1.51E-01	3.69E-03	25	404.87	632.40	8,410	0.0E+00	6.0E-02		
109693	1-Chlorobutane	1.72E+01	8.26E-02	1.00E-05	1.10E+03	6.93E-01	1.69E-02	25	351.60	542.00	7,263	0.0E+00	1.4E+00		X
110009	Furan	1.86E+01	1.04E-01	1.22E-05	1.00E+04	2.21E-01	5.39E-03	25	304.60	490.20	6,477	0.0E+00	3.5E-03		X
110543	Hexane	4.34E+01	2.00E-01	7.77E-06	1.24E+01	6.82E+01	1.66E+00	25	341.70	508.00	6,895	0.0E+00	2.0E-01		
111444	Bis(2-chloroethyl)ether	1.55E+01	6.92E-02	7.53E-06	1.72E+04	7.36E-04	1.80E-05	25	451.15	659.79	10,803	3.3E-04	0.0E+00		
115297	Endosulfan	2.14E+03	1.15E-02	4.55E-06	5.10E-01	4.58E-04	1.12E-05	25	674.43	942.94	14,000	0.0E+00	2.1E-02		X
118741	Hexachlorobenzene	5.50E+04	5.42E-02	5.91E-06	5.00E-03	5.40E-02	1.32E-03	25	582.55	825.00	14,447	4.6E-04	2.8E-03		X
120821	1,2,4-Trichlorobenzene	1.78E+03	3.00E-02	8.23E-06	4.88E+01	5.81E-02	1.42E-03	25	486.15	725.00	10,471	0.0E+00	2.0E-01		
123739	Crotonaldehyde (2-butenal)	4.82E+00	9.56E-02	1.07E-05	3.69E+04	7.99E-04	1.95E-05	25	375.20	568.00	9	5.4E-04	0.0E+00	X	
124481	Chlorodibromomethane	6.31E+01	1.96E-02	1.05E-05	2.60E+03	3.20E-02	7.81E-04	25	416.14	678.20	5,900	2.4E-05	7.0E-02	X	X
126987	Methacrylonitrile	3.58E+01	1.12E-01	1.32E-05	2.54E+04	1.01E-02	2.46E-04	25	363.30	554.00	7,600	0.0E+00	7.0E-04		
126998	2-Chloro-1,3-butadiene (chloropre	6.73E+01	8.58E-02	1.03E-05	2.12E+03	4.91E-01	1.20E-02	25	332.40	525.00	8,075	0.0E+00	7.0E-03		
127184	Tetrachloroethylene	1.55E+02	7.20E-02	8.20E-06	2.00E+02	7.53E-01	1.84E-02	25	394.40	620.20	8,288	3.0E-06	0.0E+00		
129000	Pyrene	1.05E+05	2.72E-02	7.24E-06	1.35E+00	4.50E-04	1.10E-05	25	667.95	936	14370	0.0E+00	1.1E-01		X
132649	Dibenzofuran	5.15E+03	2.38E-02	6.00E-06	3.10E+00	5.15E-04	1.26E-05	25	560	824	66400	0.0E+00	1.4E-02		X
135988	sec-Butylbenzene	9.66E+02	5.70E-02	8.12E-06	3.94E+00	5.68E-01	1.39E-02	25	446.5	679	88730	0.0E+00	1.4E-01		X
141786	Ethylacetate	6.44E+00	7.32E-02	9.70E-06	8.03E+04	5.64E-03	1.38E-04	25	350.26	523.3	7633.66	0.0E+00	3.2E+00		X
156592	cis-1,2-Dichloroethylene	3.55E+01	7.36E-02	1.13E-05	3.50E+03	1.67E-01	4.07E-03	25	333.65	544	7192	0.0E+00	3.5E-02		X
156605	trans-1,2-Dichloroethylene	5.25E+01	7.07E-02	1.19E-05	6.30E+03	3.84E-01	9.36E-03	25	320.85	516.5	6717	0.0E+00	7.0E-02		X
205992	Benzo(b)fluoranthene	1.23E+06	2.26E-02	5.56E-06	1.50E-03	4.54E-03	1.11E-04	25	715.9	969.27	17000	2.1E-04	0.0E+00	X	
218019	Chrysene	3.98E+05	2.48E-02	6.21E-06	6.30E-03	3.87E-03	9.44E-05	25	714.15	979	16455	2.1E-06	0.0E+00	X	
309002	Aldrin	2.45E+06	1.32E-02	4.86E-06	1.70E-02	6.95E-03	1.70E-04	25	603.01	839.37	15000	4.9E-03	1.1E-04		X
319846	alpha-HCH (alpha-BHC)	1.23E+03	1.42E-02	7.34E-06	2.00E+00	4.34E-04	1.06E-05	25	596.55	839.36	15000	1.8E-03	0.0E+00		
541731	1,3-Dichlorobenzene	1.98E+03	6.92E-02	7.86E-06	1.34E+02	1.27E-01	3.09E-03	25	446	684	9230.18	0.0E+00	1.1E-01		X
542756	1,3-Dichloropropene	4.57E+01	6.26E-02	1.00E-05	2.80E+03	7.24E-01	1.77E-02	25	381.15	587.38	7900	4.0E-06	2.0E-02		
630206	1,1,1,2-Tetrachloroethane	1.16E+02	7.10E-02	7.90E-06	1.10E+03	9.90E-02	2.41E-03	25	403.5	624	9768.282525	7.4E-06	1.1E-01		X
1634044	MTBE	7.26E+00	1.02E-01	1.05E-05	5.10E+04	2.56E-02	6.23E-04	25	328.3	497.1	6677.66	0.0E+00	3.0E+00		
7439976	Mercury (elemental)	5.20E+01	3.07E-02	6.30E-06	2.00E+01	4.40E-01	1.07E-02	25	629.88	1750	14127	0.0E+00	3.0E-04		

APPENDIX B

TOXICITY VALUES

DATA ENTRY SHEET

GW-SCREEN
Version 3.0; 04/03

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [X]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [ ]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (μg/L)	Chemical
75343		1,1-Dichloroethane

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	274	S	9.8	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm²)	ENTER Vadose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm³)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm³/cm³)
S				1.66	0.375	0.054

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	25	25	250

Used to calculate risk-based groundwater concentration.

CHEMICAL PROPERTIES SHEET

ABC

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3$)$^{-1}$	Reference conc., RfC (mg/m^3)
7.42E-02	1.05E-05	5.61E-03	25	6,895	330.55	523.00	3.16E+01	5.06E+03	0.0E+00	5.0E-01

END

INTERMEDIATE CALCULATIONS SHEET

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
259	0.321	0.003	9.92E-08	0.998	9.90E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
1.69E+04	1.00E+06	4.00E-04	15	7,452	2.85E-03	1.23E-01	1.75E-04	1.20E-02	4.81E-04	4.66E-03

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
259	15	1.23E+02	0.10	9.95E+01	1.20E-02	4.00E+02	1.24E+90	8.99E-04	1.10E-01	NA	5.0E-01

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	6.61E+03	6.61E+03	5.06E+06	6.61E+03

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE SUMMARY BELOW:
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

END

DATA ENTRY SHEET

GW-SCREEN
Version 3.0; 04/03

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [X]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [ ]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
75354		1,1-Dichloroethylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	274	S	9.8	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
S				1.66	0.375	0.054

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	25	25	250

Used to calculate risk-based groundwater concentration.

CHEMICAL PROPERTIES SHEET

ABC

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
9.00E-02	1.04E-05	2.60E-02	25	6,247	304.75	576.05	5.89E+01	2.25E+03	0.0E+00	2.0E-01

END

INTERMEDIATE CALCULATIONS SHEET

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
259	0.321	0.003	9.92E-08	0.998	9.90E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
1.69E+04	1.00E+06	4.00E-04	15	6,394	1.46E-02	6.28E-01	1.75E-04	1.45E-02	5.78E-04	5.61E-03

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
259	15	6.28E+02	0.10	9.95E+01	1.45E-02	4.00E+02	1.89E+74	1.05E-03	6.60E-01	NA	2.0E-01

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
NA	4.43E+02	4.43E+02	2.25E+06	4.43E+02

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE SUMMARY BELOW:
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

END

DATA ENTRY SHEET

GW-SCREEN
Version 3.0; 04/03

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [X]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [ ]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (μg/L)	Chemical
71556		1,1,1-Trichloroethane

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	274	S	9.8	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
S				1.66	0.375	0.054

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	25	25	250

Used to calculate risk-based groundwater concentration.

CHEMICAL PROPERTIES SHEET

ABC

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
7.80E-02	8.80E-06	1.72E-02	25	7,136	347.24	545.00	1.10E+02	1.33E+03	0.0E+00	2.2E+00

END

INTERMEDIATE CALCULATIONS SHEET

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
259	0.321	0.003	9.92E-08	0.998	9.90E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
1.69E+04	1.00E+06	4.00E-04	15	7,887	8.39E-03	3.61E-01	1.75E-04	1.26E-02	5.01E-04	4.87E-03

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
259	15	3.61E+02	0.10	9.95E+01	1.26E-02	4.00E+02	5.05E+85	9.33E-04	3.37E-01	NA	2.2E+00

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
NA	9.52E+03	9.52E+03	1.33E+06	9.52E+03

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE SUMMARY BELOW:
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

END

DATA ENTRY SHEET

GW-SCREEN
Version 3.0; 04/03

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [X]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [ ]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
156592		cis-1,2-Dichloroethylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	274	S	9.8	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
S				1.66	0.375	0.054

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	25	25	250

Used to calculate risk-based groundwater concentration.

CHEMICAL PROPERTIES SHEET

ABC

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3$)$^{-1}$	Reference conc., RfC (mg/m^3)
7.36E-02	1.13E-05	4.07E-03	25	7,192	333.65	544.00	3.55E+01	3.50E+03	0.0E+00	3.5E-02

END

INTERMEDIATE CALCULATIONS SHEET

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
259	0.321	0.003	9.92E-08	0.998	9.90E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
1.69E+04	1.00E+06	4.00E-04	15	7,736	2.02E-03	8.69E-02	1.75E-04	1.19E-02	4.81E-04	4.64E-03

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
259	15	8.69E+01	0.10	9.95E+01	1.19E-02	4.00E+02	6.70E+90	8.97E-04	7.79E-02	NA	3.5E-02

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	6.56E+02	6.56E+02	3.50E+06	6.56E+02

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE SUMMARY BELOW:
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

END

DATA ENTRY SHEET

GW-SCREEN
Version 3.0; 04/03

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [X]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [ ]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (μg/L)	Chemical
127184		Tetrachloroethylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	274	S	9.8	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm²)	ENTER Vadose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm³)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm³/cm³)
S				1.66	0.375	0.054

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	25	25	250

Used to calculate risk-based groundwater concentration.

CHEMICAL PROPERTIES SHEET

ABC

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
7.20E-02	8.20E-06	1.84E-02	25	8,288	394.40	620.20	1.55E+02	2.00E+02	3.0E-06	0.0E+00

END

INTERMEDIATE CALCULATIONS SHEET

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
259	0.321	0.003	9.92E-08	0.998	9.90E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
1.69E+04	1.00E+06	4.00E-04	15	9,555	7.72E-03	3.32E-01	1.75E-04	1.16E-02	4.63E-04	4.50E-03

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} (μg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (μg/m^3)	Unit risk factor, URF (μg/m^3)$^{-1}$	Reference conc., RfC (mg/m^3)
259	15	3.32E+02	0.10	9.95E+01	1.16E-02	4.00E+02	7.00E+92	8.72E-04	2.90E-01	3.0E-06	NA

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
4.70E+00	NA	4.70E+00	2.00E+05	4.70E+00

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE SUMMARY BELOW:
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

END

DATA ENTRY SHEET

GW-SCREEN
Version 3.0; 04/03

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [X]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [ ]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (μg/L)	Chemical
79016		Trichloroethylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	274	S	9.8	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm²)	ENTER Vadose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm³)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm³/cm³)
S				1.66	0.375	0.054

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	25	25	250

Used to calculate risk-based groundwater concentration.

CHEMICAL PROPERTIES SHEET

ABC

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3$)$^{-1}$	Reference conc., RfC (mg/m^3)
7.80E-02	8.80E-06	1.72E-02	25	7,136	347.24	545.00	1.10E+02	1.33E+03	0.0E+00	2.2E+00

END

INTERMEDIATE CALCULATIONS SHEET

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
259	0.321	0.003	9.92E-08	0.998	9.90E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
1.69E+04	1.00E+06	4.00E-04	15	7,887	8.39E-03	3.61E-01	1.75E-04	1.26E-02	5.01E-04	4.87E-03

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
259	15	3.61E+02	0.10	9.95E+01	1.26E-02	4.00E+02	5.05E+85	9.33E-04	3.37E-01	NA	2.2E+00

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
NA	9.52E+03	9.52E+03	1.33E+06	9.52E+03

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE SUMMARY BELOW:
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

END

DATA ENTRY SHEET

GW-SCREEN
Version 3.0; 04/03

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [X]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [ ]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (μg/L)	Chemical
156592		cis-1,2-Dichloroethylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	274	S	9.8	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
S				1.66	0.375	0.054

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	25	25	250

Used to calculate risk-based groundwater concentration.

CHEMICAL PROPERTIES SHEET

ABC

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3$)$^{-1}$	Reference conc., RfC (mg/m^3)
7.36E-02	1.13E-05	4.07E-03	25	7,192	333.65	544.00	3.55E+01	3.50E+03	0.0E+00	3.5E-02

END

INTERMEDIATE CALCULATIONS SHEET

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
259	0.321	0.003	9.92E-08	0.998	9.90E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
1.69E+04	1.00E+06	4.00E-04	15	7,736	2.02E-03	8.69E-02	1.75E-04	1.19E-02	4.81E-04	4.64E-03

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} (μg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (μg/m^3)	Unit risk factor, URF (μg/m^3)$^{-1}$	Reference conc., RfC (mg/m^3)
259	15	8.69E+01	0.10	9.95E+01	1.19E-02	4.00E+02	6.70E+90	8.97E-04	7.79E-02	NA	3.5E-02

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	6.56E+02	6.56E+02	3.50E+06	6.56E+02

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE SUMMARY BELOW:
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

END

DATA ENTRY SHEET

GW-SCREEN
Version 3.0; 04/03

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [X]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [ ]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (μg/L)	Chemical
127184		Tetrachloroethylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	274	S	9.8	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
S				1.66	0.375	0.054

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	25	25	250

Used to calculate risk-based groundwater concentration.

CHEMICAL PROPERTIES SHEET

ABC

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
7.20E-02	8.20E-06	1.84E-02	25	8,288	394.40	620.20	1.55E+02	2.00E+02	3.0E-06	0.0E+00

END

INTERMEDIATE CALCULATIONS SHEET

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm³/cm³)	Vadose zone effective total fluid saturation, S_{te} (cm³/cm³)	Vadose zone soil intrinsic permeability, k_i (cm²)	Vadose zone soil relative air permeability, k_{rg} (cm²)	Vadose zone soil effective vapor permeability, k_v (cm²)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm³/cm³)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm³/cm³)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm³/cm³)	Floor-wall seam perimeter, X_{crack} (cm)
259	0.321	0.003	9.92E-08	0.998	9.90E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm³/s)	Area of enclosed space below grade, A_B (cm²)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m³/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm²/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm²/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm²/s)
1.69E+04	1.00E+06	4.00E-04	15	9,555	7.72E-03	3.32E-01	1.75E-04	1.16E-02	4.63E-04	4.50E-03

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} (μg/m³)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm³/s)	Crack effective diffusion coefficient, D^{crack} (cm²/s)	Area of crack, A_{crack} (cm²)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (μg/m³)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m³)
259	15	3.32E+02	0.10	9.95E+01	1.16E-02	4.00E+02	7.00E+92	8.72E-04	2.90E-01	3.0E-06	NA

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
4.70E+00	NA	4.70E+00	2.00E+05	4.70E+00

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE SUMMARY BELOW:
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

END

DATA ENTRY SHEET

GW-SCREEN
Version 3.0; 04/03

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [X]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [ ]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
79016		Trichloroethylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	274	S	9.8	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm²)	ENTER Vadose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm³)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm³/cm³)
S				1.66	0.375	0.054

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	25	25	250

Used to calculate risk-based groundwater concentration.

CHEMICAL PROPERTIES SHEET

ABC

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3$)$^{-1}$	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	1.1E-04	4.0E-02

END

INTERMEDIATE CALCULATIONS SHEET

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
259	0.321	0.003	9.92E-08	0.998	9.90E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
1.69E+04	1.00E+06	4.00E-04	15	8,559	4.73E-03	2.04E-01	1.75E-04	1.28E-02	5.09E-04	4.94E-03

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} (μg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (μg/m^3)	Unit risk factor, URF (μg/m^3)$^{-1}$	Reference conc., RfC (mg/m^3)
259	15	2.04E+02	0.10	9.95E+01	1.28E-02	4.00E+02	4.15E+84	9.45E-04	1.92E-01	1.1E-04	4.0E-02

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
1.93E-01	3.04E+02	1.93E-01	1.47E+06	1.93E-01

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE SUMMARY BELOW:
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

END

APPENDIX C

SENSITIVITY ANALYSIS DATA

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
1.73E+00	2.72E+03	1.73E+00	1.47E+06	1.73E+00

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE SUMMARY BELOW:
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
1.73E+00	2.72E+03	1.73E+00	1.47E+06	1.73E+00

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE SUMMARY BELOW:
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
6.26E-01	9.84E+02	6.26E-01	1.47E+06	6.26E-01

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE SUMMARY BELOW:
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

END

]

Table 4
CANCER RISK AND HAZARD QUOTIENT EVALUATION:
SUBSURFACE VAPOR INTRUSION INTO BUILDINGS FROM ON-SITE GROUNDWATER (MW-4) - Loamy Sand
Commercial/Industrial Receptor
Techalloy, Union, Illinois

Chemical	Maximum Concentration (MW-4)	Units	GWSCREEN (1) Risk-based Concentration (ug/L)		Cancer Risk (unitless)	Hazard Quotient (unitless)
			Cancer	Noncancer		
VOCs						
1,1-Dichloroethene	ND	ug/L	--	4.43E+02	--	--
1,1-Dichloroethane	21	ug/L	--	6.61E+03	--	3.2E-03
1,1,1-Trichloroethane	59	ug/L	--	9.52E+03	--	6.2E-03
Trichloroethene	5.4	ug/L	6.26E-01	9.84E+02	8.6E-06	5.5E-03
Tetrachloroethene	55	ug/L	1.51E+01	--	3.6E-06	--
cis-1,2-Dichloroethene	ND	ug/L	--	6.56E+02	--	--
					1E-05	--
					--	1E-02

(1) Risk-based soil concentration based on Johnson and Ettinger Model (U.S. EPA, 2003).

Ca - carcinogenic endpoint.

NC - noncarcinogenic endpoint.

Table 5
CANCER RISK AND HAZARD QUOTIENT EVALUATION:
SUBSURFACE VAPOR INTRUSION INTO BUILDINGS FROM ON-SITE GROUNDWATER (MW-100) - Sandy Loam
Commercial/Industrial Receptor
Techalloy, Union, Illinois

Chemical	Maximum Concentration (MW-100)	Units	GWSCREEN (1) Risk-based Concentration (ug/L)		Cancer Risk (unitless)	Hazard Quotient (unitless)
			Cancer	Noncancer		
VOCs						
1,1-Dichloroethene	ND	ug/L	--	4.43E+02	--	--
1,1-Dichloroethane	ND	ug/L	--	6.61E+03	--	--
1,1,1-Trichloroethane	6	ug/L	--	9.52E+03	--	5.8E-04
Trichloroethene	ND	ug/L	1.73E+00	2.72E+03	--	--
Tetrachloroethene	16	ug/L	4.24E+01	--	3.7E-07	--
cis-1,2-Dichloroethene	ND	ug/L	--	6.56E+02	--	--
					4E-07	--
					--	6E-04

(1) Risk-based soil concentration based on Johnson and Ettinger Model (U.S. EPA, 2003).

Ca - carcinogenic endpoint.

NC - noncarcinogenic endpoint.

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
4.24E+01	NA	4.24E+01	2.00E+05	4.24E+01

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE SUMMARY BELOW:
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

END

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

15 April 1999

VIA FACSIMILE AND
FIRST CLASS MAIL

REPLY TO THE ATTENTION OF:

DE-9J

Mr. Carlos J. Serna
Senior Project Manager
Roy F. Weston, Inc.
Suite 400
3 Hawthorn Parkway
Vernon Hills, IL 60061-1450
(Fax No. 847-918-4055)

RE: Techalloy Co., Inc.
Union, IL Facility
ILD 005 178 975
Corrective Measures Implementation Cost Estimate

Dear Mr. Serna:

As you are well aware, Techalloy Co., Inc. ("Techalloy") and the United States Environmental Protection Agency ("EPA") are nearing the conclusion of negotiations for a Corrective Measures Implementation ("CMI") Administrative Order on Consent ("Consent Order"). One outstanding issue has to do with Techalloy's requirement to establish financial assurance for implementation of the selected remedial alternative, pursuant to Section XXII, "Financial Responsibility," of the Consent Order. You and I have exchanged electronic mail and have discussed the matter of financial assurance and remediation costs on at least two occasions by telephone in February of this year. Attorneys for Techalloy and EPA have also discussed the matter of financial assurance. Techalloy has asked that the number be further reduced from the figures you and I discussed earlier this year. It appears that there is now some uncertainty as to what number is to be incorporated into the CMI Consent Order. Hence, the purpose of this letter.

I have reviewed the cost estimates contained in the *Corrective Measures Study Report* (August 1997, Roy F. Weston, Inc.), ("CMS Report"), and in the EPA's Statement of Basis. The costs considered reflect components from CMS Report alternatives S-2 (soil remediation) and GW-2A (groundwater remediation). On 9

February 1999, you sent a message to me via electronic mail. In that message you indicated, "[t]he total cost for the remediation described in the [S]tatement of [B]asis will cost Techalloy $3,060,800." This included $1,085,800 for the soil remediation component and $1,975,600 for the groundwater component.[1] The cost for the groundwater pump and treat system has been deducted because construction of this component has already been completed under an interim remedial measure. In summary, we had a general understanding that the remediation costs, including present worth calculations for yearly groundwater monitoring and operations and maintenance ("O&M"), were approximately $3.1 million. These costs included a contingency factor of +25%. In fact, *all* the cost estimates provided by Techalloy (and Weston) in the CMS Report included this same contingency factor. This is an important point to note, especially in light of the fact that Techalloy is now requesting that the financial assurance requirement be reduced specifically by way of reducing the contingency factor[2] consistently applied in the remedial alternatives cost work-ups in the CMS Report.

I do believe there may be an error in the cost estimate. As I calculate the annual costs for groundwater pump and treat and for air sparging ("AS") and soil vapor extraction ("SVE"), I arrive at a total cost of $1,932,000[3], versus the

---

[1]The costs you provided included a +25% contingency, as well as present worth calculations for annual operations and maintenance costs. The O&M costs accounted for an assumed interest factor of 7% annually, and were determined for a 10-year life for the soil vapor extraction (SVE) component and a 30-year life for the groundwater pump and treat system. Alternative S-2 was determined to be $1,140,000.00, less the capital cost of a treatment building (set at $54,200.00), which yields $1,085,800.00. The groundwater alternative, GW-2A, slightly overestimates – according to your 9 February 1999 e-mail – the SVE system, but you suggested keeping the figures as presented in the CMS Report (*i.e.*, $3,009,600.00), less the cost of groundwater treatment (*i.e.*, presented in alternative GW-2 as a single lump sum of $1,034,600.00), which amounts to $1,975,600.00. The total, with the deductions noted, equals $3,060,800.00.

[2]Attorneys for Techalloy have suggested reducing the contingency factor from +25% to either +10% or +15%. This would amount to a 40% - 60% decrease in monies considered for unforeseen cost overruns.

[3]AS/SVE annual O&M costs of $60,600.00 per year @ 10 years = $606,000.00. Interim measures pump and treat annual O&M costs of $37,400.00 @ 30 years = $1,122,000.00. Groundwater monitoring costs of $6,800.00 per year @ 30 years = $204,000.00. These three components total $1,932,000.00 vs. the $2,932,000.00 indicated in the GW-2A cost estimate. Adding a +25% contingency to these annual O&M costs results in $2,415,000.00, not the

$2,932,000 shown in the alternative GW-2A cost estimate.[4] The total present worth for the 30-year O&M costs is calculated to be $1,217,000.00. This number may be correct, as the three individual components appear reasonable, but should be revisited.

There are several other concerns which should be addressed. For ease of reference, they are enumerated below:

(1) The CMS Report cost estimates are now nearly two years old. We suggest that Techalloy provide EPA with a revised cost estimate. Minor increases in the construction cost index ("CCI")[5] could affect the 1997 construction cost estimates. Granted, this will not result in significant changes to the capital cost estimates. However, it does reflect some increases over time in construction costs that should be taken into consideration.

(2) GW-2A includes costs for two vapor phase carbon units and two blowers. In the revised cost estimate "Comments" column, please provide the size of the blowers, based on estimated air flow requirements through the AS/SVE system. Also, in the same column, provide a description of the carbon units. Will both be in service simultaneously, or is one a back-up? Did Weston consult available adsorption isotherms and soil-water partitioning coefficients for the constituents of concern in sizing the carbon beds and in determining breakthrough? Based on the concentrations of volatile organics in the groundwater and flowrates through the carbon units, has any estimate been made for carbon replacement or regeneration costs? Perhaps some of these questions will be answered during the pilot study. If so, please indicate that, and we can discuss at a later date.

$3,665,000.00 indicated in the CMS Report as "SUB-TOTAL: (O&M Costs) with 25% contingency."

[4]The $1,000,000.00 difference could be the result of a simple error in addition.

[5]The construction cost index ("CCI") for August 1997 (when the CMS Report cost estimates were performed) was 545.0. In January 1999, the CCI was 558.5. See *Chemical and Engineering News* (February 1999). This reflects an increase of roughly 2.5%.

(3) The estimates for the AS/SVE trench, blower piping and compressor piping may be low. They are given at 1500 linear feet. Quick measurements taken off of Figure 3-5 of the CMS Report indicate that the estimates are low, and more on the order of 2500+ linear feet.

(4) Alternative S-2 includes stabilization costs of $30.00 per cubic yard of impacted soil. We ask that you revisit this value to include increases, if any, in treatment costs by vendors since mid-1997.

(5) Cost work-up GW-2A, under "AS/SVE ANNUAL OPERATIONS AND MAINTENANCE COSTS" states in the column labeled "Comments" that it is assumed "carbon would only be needed initially." Are you anticipating a short-term use for the carbon beds, and that the solvent-laden air stream from the SVE system could be discharged directly to the environment?

(6) EPA is concerned that the administrative record ("AR") is maintained in such a way as to allow for the general public to gather information on this site with as little difficulty as possible. With information repositories containing considerable amounts of technical information, this is quite challenging. We believe it would be in the best interest of the public record if another cost estimate was performed and submitted to this Agency. The selected alternative includes components from two alternatives in the CMS Report, and even then, some individual components – *e.g.*, the cost of the treatment building in alternative S-2 – are deleted from the overall cost estimate, for reasons which you and I have shared in our electronic correspondence, but which would not be readily discernable by those who might be inclined to review the AR.

(7) A new cost work-up would allow for revisions to the contingency factor, as requested by Techalloy. If Weston were to revisit the CMS Report cost estimates and take into consideration any recent construction, labor and/or vendor increases, EPA would be willing to allow a +10% contingency factor for all capital cost figures. Given the uncertainty of projecting costs over a 10-year and, more significantly, over a 30-year project life, we believe a +15% contingency factor for annual O&M and groundwater monitoring cost estimates is reasonable.

We believe a recalculation of remediation costs, given all the considerations above, is appropriate at this time. Consideration of minor cost increases over the past two years, coupled with a reduction in contingencies from a universal +25% to +10% for capital expenditures and +15% for long-term O&M and monitoring costs, should result in a figure lower than the roughly $3.1 million figure we have discussed in the past.

In the interest of expediting final resolution of this matter and filing of the Consent Order, we request that you provide EPA with a revised cost estimate for the selected remedy by 3 May 1999.

If you have any questions concerning this letter, please feel free to contact me directly at (312) 886-4582. My e-mail address is: valentino.michael@epa.gov.

Sincerely yours,

Michael Valentino

Michael Valentino
Corrective Action Project Manager

cc: Margaret Rosegay, Esq., of Pillsbury, Madison and Sutro
Jacqueline Kline, Asst. Regional Counsel, EPA-Region 5, ORC

Non-responsive

[redacted]

Non-responsive

[redacted]

Non-responsive

[redacted]

Non-responsive

[redacted]

Non-responsive

[redacted]

Non-responsive

[redacted]

Non-responsive

[redacted]

Non-responsive

[redacted]

Non-responsive

[redacted]

Non-responsive

[redacted]

Non-responsive

[redacted]

Please print or type with ELITE type (12 characters/inch) in the unshaded areas only.

GSA No. 0246-EPA-OT Expiration Date 12/31/86

EPA

U.S. ENVIRONMENTAL PROTECTION AGENCY

NOTIFICATION OF HAZARDOUS WASTE ACTIVITY

INSTALLATION'S EPA I.D. NO.

I. NAME OF INSTALLATION

II. INSTALLATION MAILING ADDRESS

III. LOCATION OF INSTALLATION

PLEASE PLACE LABEL IN THIS SPACE

INSTRUCTIONS: If you received a preprinted label, affix it in the space at left. If any of the information on the label is incorrect, draw a line through it and supply the correct information in the appropriate section below. If the label is complete and correct, leave Items I, II, and III below blank. If you did not receive a preprinted label, complete all items. "Installation" means a single site where hazardous waste is generated, treated, stored and/or disposed of, or a transporter's principal place of business. Please refer to the INSTRUCTIONS FOR FILING NOTIFICATION before completing this form. The information requested herein is required by law (Section 3010 of the Resource Conservation and Recovery Act).

DETACH

FOR OFFICIAL USE ONLY

COMMENTS

C

INSTALLATION'S EPA I.D. NUMBER	T/A C	APPROVED	DATE RECEIVED (yr., mo., & day)
F	1		

I. NAME OF INSTALLATION

TECHALLOY ILLINOIS INC.

II. INSTALLATION MAILING ADDRESS

STREET OR P.O. BOX

3 PO BOX 423

CITY OR TOWN	ST.	ZIP CODE
4 UNION	IL	60180

RECEIVED

DEC 12 1985

IEPA/DLPC

III. LOCATION OF INSTALLATION

STREET OR ROUTE NUMBER

5 OLSON & JEFFERSON RDS

CITY OR TOWN	ST.	ZIP CODE
6 UNION	IL	60180

IV. INSTALLATION CONTACT

NAME AND TITLE (last, first, & job title)	PHONE NO. (area code & no.)
2 MILLER GEORGE MAINT SUPT	815 923 2131

V. OWNERSHIP

A. NAME OF INSTALLATION'S LEGAL OWNER

8 TECHALLOY ILLINOIS INC.

DETACH

B. TYPE OF OWNERSHIP (enter the appropriate letter into box)

F = FEDERAL
M = NON-FEDERAL

M

VI. TYPE OF HAZARDOUS WASTE ACTIVITY (enter "X" in the appropriate box(es))

☒ A. GENERATION
☐ B. TRANSPORTATION (complete item VII)
☒ C. TREAT/STORE/DISPOSE
☐ D. UNDERGROUND INJECTION

VII. MODE OF TRANSPORTATION (transporters only – enter "X" in the appropriate box(es))

☐ A. AIR ☐ B. RAIL ☐ C. HIGHWAY ☐ D. WATER ☐ E. OTHER (specify):

VIII. FIRST OR SUBSEQUENT NOTIFICATION

Mark "X" in the appropriate box to indicate whether this is your installation's first notification of hazardous waste activity or a subsequent notification. If this is not your first notification, enter your installation's EPA I.D. Number in the space provided below.

☐ A. FIRST NOTIFICATION
☒ B. SUBSEQUENT NOTIFICATION (complete item C)

C. INSTALLATION'S EPA I.D. NO.

ILD0005178775

IX. DESCRIPTION OF HAZARDOUS WASTES

Please go to the reverse of this form and provide the requested information.

I.D. – FOR OFFICIAL USE ONLY

W

IX. DESCRIPTION OF HAZARDOUS WASTES *(continued from front)*

A. HAZARDOUS WASTES FROM NON–SPECIFIC SOURCES. Enter the four–digit number from 40 CFR Part 261.31 for each listed hazardous waste from non–specific sources your installation handles. Use additional sheets if necessary.

1	2	3	4	5	6
F001					
7	8	9	10	11	12

B. HAZARDOUS WASTES FROM SPECIFIC SOURCES. Enter the four–digit number from 40 CFR Part 261.32 for each listed hazardous waste from specific industrial sources your installation handles. Use additional sheets if necessary.

13	14	15	16	17	18
K062					
19	20	21	22	23	24
25	26	27	28	29	30

C. COMMERCIAL CHEMICAL PRODUCT HAZARDOUS WASTES. Enter the four–digit number from 40 CFR Part 261.33 for each chemical substance your installation handles which may be a hazardous waste. Use additional sheets if necessary.

31	32	33	34	35	36
37	38	39	40	41	42
43	44	45	46	47	48

D. LISTED INFECTIOUS WASTES. Enter the four–digit number from 40 CFR Part 261.34 for each listed hazardous waste from hospitals, veterinary hospitals, medical and research laboratories your installation handles. Use additional sheets if necessary.

49	50	51	52	53	54

E. CHARACTERISTICS OF NON–LISTED HAZARDOUS WASTES. Mark "X" in the boxes corresponding to the characteristics of non–listed hazardous wastes your installation handles. *(See 40 CFR Parts 261.21 – 261.24.)*

- [ ] 1. IGNITABLE (D001)
- [ ] 2. CORROSIVE (D002)
- [x] 3. REACTIVE (D003)
- [ ] 4. TOXIC (D000)

X. CERTIFICATION

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

SIGNATURE	NAME & OFFICIAL TITLE *(type or print)*	DATE SIGNED
George Miller	George Miller, MAINTENANCE SUPERVISOR	12-2-85

EPA Form 8700-12 (6-85) REVERSE

FORM 3 RCRA

EPA

U.S. ENVIRONMENTAL PROTECTION AGENCY
HAZARDOUS WASTE PERMIT APPLICATION
Consolidated Permits Program
(This information is required under Section 3005 of RCRA.)

I. EPA I.D. NUMBER

F | ILD005178975 | T/A C | 1

FOR OFFICIAL USE ONLY

APPLICATION APPROVED	DATE RECEIVED (yr., mo., & day)	COMMENTS

II. FIRST OR REVISED APPLICATION

Place an "X" in the appropriate box in A or B below *(mark one box only)* to indicate whether this is the first application you are submitting for your facility or a revised application. If this is your first application and you already know your facility's EPA I.D. Number, or if this is a revised application, enter your facility's EPA I.D. Number in Item I above.

A. FIRST APPLICATION *(place an "X" below and provide the appropriate date)*

☐ 1. EXISTING FACILITY *(See instructions for definition of "existing" facility. Complete item below.)*

☐ 2. NEW FACILITY *(Complete item below.)*

C 8 | YR. | MO. | DAY | FOR EXISTING FACILITIES, PROVIDE THE DATE (yr., mo., & day) OPERATION BEGAN OR THE DATE CONSTRUCTION COMMENCED *(use the boxes to the left)*

YR. | MO. | DAY | FOR NEW FACILITIES, PROVIDE THE DATE *(yr., mo., & day)* OPERATION BEGAN OR IS EXPECTED TO BEGIN

B. REVISED APPLICATION *(place an "X" below and complete Item I above)*

☒ 1. FACILITY HAS INTERIM STATUS

☐ 2. FACILITY HAS A RCRA PERMIT

III. PROCESSES – CODES AND DESIGN CAPACITIES

A. **PROCESS CODE** – Enter the code from the list of process codes below that best describes each process to be used at the facility. Ten lines are provided for entering codes. If more lines are needed, enter the code*(s)* in the space provided. If a process will be used that is not included in the list of codes below, then describe the process *(including its design capacity)* in the space provided on the form *(Item III-C)*.

B. **PROCESS DESIGN CAPACITY** – For each code entered in column A enter the capacity of the process.
1. AMOUNT – Enter the amount.
2. UNIT OF MEASURE – For each amount entered in column B(1), enter the code from the list of unit measure codes below that describes the unit of measure used. Only the units of measure that are listed below should be used.

PROCESS	PROCESS CODE	APPROPRIATE UNITS OF MEASURE FOR PROCESS DESIGN CAPACITY
Storage:		
CONTAINER *(barrel, drum, etc.)*	S01	GALLONS OR LITERS
TANK	S02	GALLONS OR LITERS
WASTE PILE	S03	CUBIC YARDS OR CUBIC METERS
SURFACE IMPOUNDMENT	S04	GALLONS OR LITERS
Disposal:		
INJECTION WELL	D79	GALLONS OR LITERS
LANDFILL	D80	ACRE-FEET *(the volume that would cover one acre to a depth of one foot)* OR HECTARE-METER
LAND APPLICATION	D81	ACRES OR HECTARES
OCEAN DISPOSAL	D82	GALLONS PER DAY OR LITERS PER DAY
SURFACE IMPOUNDMENT	D83	GALLONS OR LITERS
Treatment:		
TANK	T01	GALLONS PER DAY OR LITERS PER DAY
SURFACE IMPOUNDMENT	T02	GALLONS PER DAY OR LITERS PER DAY
INCINERATOR	T03	TONS PER HOUR OR METRIC TONS PER HOUR; GALLONS PER HOUR OR LITERS PER HOUR
OTHER *(Use for physical, chemical, thermal or biological treatment processes not occurring in tanks, surface impoundments or incinerators. Describe the processes in the space provided; Item III-C.)*	T04	GALLONS PER DAY OR LITERS PER DAY

UNIT OF MEASURE	UNIT OF MEASURE CODE
GALLONS	G
LITERS	L
CUBIC YARDS	Y
CUBIC METERS	C
GALLONS PER DAY	U
LITERS PER DAY	V
TONS PER HOUR	D
METRIC TONS PER HOUR	W
GALLONS PER HOUR	E
LITERS PER HOUR	H
ACRE-FEET	A
HECTARE-METER	F
ACRES	B
HECTARES	Q

EXAMPLE FOR COMPLETING ITEM III *(shown in line numbers X-1 and X-2 below)*: A facility has two storage tanks, one tank can hold 200 gallons and the other can hold 400 gallons. The facility also has an incinerator that can burn up to 20 gallons per hour.

C | DUP | T/A C | 1

LINE NUMBER	A. PROCESS CODE (from list above)	B. PROCESS DESIGN CAPACITY 1. AMOUNT (specify)	2. UNIT OF MEASURE (enter code)	FOR OFFICIAL USE ONLY
X-1	S02	600	G	
X-2	T03	20	E	
1	T01	2000	G	
2				
3				
4				
5		RECEIVED		
6		DEC 1 ... 85		
7		IEPA-DLPC		
8				
9				
10				

III. PROCESSES (continued)

C. SPACE FOR ADDITIONAL PROCESS CODES OR FOR DESCRIBING OTHER PROCESSES (code "T04"). FOR EACH PROCESS ENTERED HERE INCLUDE DESIGN CAPACITY.

N/A

IV. DESCRIPTION OF HAZARDOUS WASTES

A. **EPA HAZARDOUS WASTE NUMBER** — Enter the four–digit number from 40 CFR, Subpart D for each listed hazardous waste you will handle. If you handle hazardous wastes which are not listed in 40 CFR, Subpart D, enter the four–digit number*(s)* from 40 CFR, Subpart C that describes the characteristics and/or the toxic contaminants of those hazardous wastes.

B. ESTIMATED ANNUAL QUANTITY — For each **listed waste** entered in column A estimate the quantity of that waste that will be handled on an annual basis. For each characteristic or toxic **contaminant** entered in column A estimate the total annual quantity of all the non–listed waste*(s)* that will be handled which possess that characteristic or contaminant.

C. UNIT OF MEASURE — For each quantity entered in column B enter the unit of measure code. Units of measure which must be used and the appropriate codes are:

ENGLISH UNIT OF MEASURE	CODE	METRIC UNIT OF MEASURE	CODE
POUNDS	P	KILOGRAMS	K
TONS	T	METRIC TONS	M

If facility records use any other unit of measure for quantity, the units of measure must be converted into one of the required units of measure taking into account the appropriate density or specific gravity of the waste.

D. **PROCESSES**

1. PROCESS CODES:
   For listed hazardous waste: For each **listed** hazardous waste entered in column A select the code*(s)* from the list of process codes contained in Item III to indicate how the waste will be stored, treated, and/or disposed of at the facility.
   For non–listed hazardous wastes: For each characteristic or toxic contaminant entered in column A, select the code*(s)* from the list of process codes contained in Item III to indicate **all** the processes that will be used to store, treat, and/or dispose of all the non–listed hazardous wastes that possess that characteristic or toxic contaminant.
   Note: Four spaces are provided for entering process codes. If more are needed: (1) Enter the first three as described above; (2) Enter "000" in the extreme right box of Item IV-D(1); and (3) Enter in the space provided on page 4, the line number and the additional code*(s)*.

2. PROCESS DESCRIPTION: If a code is not listed for a process that will be used, describe the process in the space provided on the form.

NOTE: HAZARDOUS WASTES DESCRIBED BY MORE THAN ONE EPA HAZARDOUS WASTE NUMBER — Hazardous wastes that can be described by more than one EPA Hazardous Waste Number shall be described on the form as follows:

1. Select one of the EPA Hazardous Waste Numbers and enter it in column A. On the same line complete columns B,C, and D by estimating the total annual quantity of the waste and describing all the processes to be used to treat, store, and/or dispose of the waste.
2. In column A of the next line enter the other EPA Hazardous Waste Number that can be used to describe the waste. In column D(2) on that line enter "included with above" and make no other entries on that line.
3. Repeat step 2 for each other EPA Hazardous Waste Number that can be used to describe the hazardous waste.

EXAMPLE FOR COMPLETING ITEM IV *(shown in line numbers X-1, X-2, X-3, and X-4 below)* — A facility will treat and dispose of an estimated 900 pounds per year of chrome shavings from leather tanning and finishing operation. In addition, the facility will treat and dispose of three non–listed wastes. Two wastes are corrosive only and there will be an estimated 200 pounds per year of each waste. The other waste is corrosive and ignitable and there will be an estimated 100 pounds per year of that waste. Treatment will be in an incinerator and disposal will be in a landfill.

LINE NO.	A. EPA HAZARD. WASTE NO (enter code)	B. ESTIMATED ANNUAL QUANTITY OF WASTE	C. UNIT OF MEASURE (enter code)	D. PROCESSES 1. PROCESS CODES (enter)				D. PROCESSES 2. PROCESS DESCRIPTION (if a code is not entered in D(1))
X-1	K 0 5 4	900	P	T 0 3	D 8 0			
X-2	D 0 0 2	400	P	T 0 3	D 8 0			
X-3	D 0 0 1	100	P	T 0 3	D 8 0			
X-4	D 0 0 2							included with above

CONTINUE ON PAGE 3

Continued from page 2.
NOTE: Photocopy this page before completing if you have more than 26 wastes to list.

Form Approved OMB No. 158-S80004

EPA I.D. NUMBER (enter from page 1)

	T/A	C
		1

FOR OFFICIAL USE ONLY

W	DUP	T/A	C	DUP
			2	

IV. DESCRIPTION OF HAZARDOUS WASTES *(continued)*

LINE NO.	A. EPA HAZARD. WASTE NO. (enter code)	B. ESTIMATED ANNUAL QUANTITY OF WASTE	C. UNIT OF MEASURE (enter code)	D. PROCESSES 1. PROCESS CODES (enter)				D. PROCESSES 2. PROCESS DESCRIPTION (if a code is not entered in D(1))
1	K062	258,960	P	S02	T01			
2	D003	16,600	P	T01				
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								RECEIVED
19								DEC 1 0 1985
20								IEPA-DLPC
21								
22								
23								
24								
25								
26								

EPA Form 3510-3 (6-80)

CONTINUE ON REVERSE

(enter "A", "B", "C", etc. behind the "3" to identify photocopied pages)

Continued from the front.

IV. DESCRIPTION OF HAZARDOUS WASTES *(continued)*

E. USE THIS SPACE TO LIST ADDITIONAL PROCESS CODES FROM ITEM D(1) ON PAGE 3.

EPA I.D. NO. *(enter from page 1)*

F ILD005178975 6

V. FACILITY DRAWING

All existing facilities must include in the space provided on page 5 a scale drawing of the facility *(see instructions for more detail).*

VI. PHOTOGRAPHS

All existing facilities must include photographs *(aerial or ground–level)* that clearly delineate all existing structures; existing storage, treatment and disposal areas; and sites of future storage, treatment or disposal areas *(see instructions for more detail).*

VII. FACILITY GEOGRAPHIC LOCATION

LATITUDE *(degrees, minutes, & seconds)*	LONGITUDE *(degrees, minutes, & seconds)*

VIII. FACILITY OWNER

☐ A. If the facility owner is also the facility operator as listed in Section VIII on Form 1, "General Information", place an "X" in the box to the left and skip to Section IX below.

B. If the facility owner is not the facility operator as listed in Section VIII on Form 1, complete the following items:

1. NAME OF FACILITY'S LEGAL OWNER	2. PHONE NO. *(area code & no.)*
E	

3. STREET OR P.O. BOX	4. CITY OR TOWN	5. ST.	6. ZIP CODE
F	G		

IX. OWNER CERTIFICATION

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

A. NAME *(print or type)*	B. SIGNATURE	C. DATE SIGNED
William Piatt	[signature]	12/2/80

X. OPERATOR CERTIFICATION

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

A. NAME *(print or type)*	B. SIGNATURE	C. DATE SIGNED
William Piatt	[signature]	12/2/80

CONTINUE ON PAGE 5

V. FACILITY DRAWING (see page 4)

ATTACHMENT 2

Certification Regarding Potential Releases from Solid Waste Management Units

Attachment 2   Reply To E.P.A.

LAW OFFICES

DRINKER BIDDLE & REATH

PHILADELPHIA NATIONAL BANK BUILDING
BROAD AND CHESTNUT STREETS
PHILADELPHIA, PA. 19107
TELEX: 834684 • DBRSMAC
(215) 988-2700

SUITE [illegible]
17[illegible] N STREET, N.W.
WASHINGTON, D.C. 20036
(202) [illegible]-7400

405 PARK AVENUE
NEW YORK, N.Y. 10022
(212) [illegible]

DIRECT DIAL (215) 988- 2614

March 13, 1986

Mr. George Miller
Maintenance Superintendent
Techalloy Illinois, Inc.
P.O. Box 423
Union, IL 60181

Mr. William Pigott
Techalloy Illinois, Inc.
P.O. Box 423
Union, IL 60181

Re: Response to EPA Request for Information

Dear Bill and George:

Enclosed for your review is a draft response to the EPA request for information. Please feel free to call if you have any questions.

Very truly yours,

Virginia Gibson-Mason

Virginia Gibson-Mason

VGM:ctf
Encl.

cc: Mr. Henry Lopes (w/encl.)
James Eiseman, Jr., Esq. (w/encl.)

CERTIFICATION REGARDING POTENTIAL RELEASES FROM
SOLID WASTE MANAGEMENT UNITS

FACILITY NAME: Techalloy Illinois, Inc.

EPA I.D. NUMBER: ILD005178975

LOCATION CITY: Olsen and Jefferson Roads, Union

STATE: Illinois

1. Are there any of the following solid waste management units (existing or closed) at your facility? NOTE - DO NOT INCLUDE HAZARDOUS WASTE UNITS CURRENTLY SHOWN IN YOUR PART A APPLICATION

	YES	NO
• Landfill		X
• Surface Impoundment		X
• Land Farm		X
• Waste Pile		X
• Incinerator		X
• Storage Tank (Above Ground)		X
• Storage Tank (Underground)		X
• Container Storage Area	X	
• Injection Wells		X
• Wastewater Treatment Units		X
• Transfer Stations		X
• Waste Recycling Operations		X
• Waste Treatment, Detoxification	X	
• Other ______		

2. If there are "Yes" answers to any of the items in Number 1 above, please provide a description of the wastes that were stored, treated or disposed of in each unit. In particular, please focus on whether or not the wastes would be considered as hazardous wastes or hazardous constituents under RCRA. Also include any available data on quantities or volume of wastes disposed of and the dates of disposal. Please also provide a description of each unit and include capacity, dimensions and location at facility. Provide a site plan if available.

(See attached sheet.)

NOTE: Hazardous wastes are those identified in 40 CFR 261. Hazardous constituents are those listed in Appendix VIII of 40 CFR Part 261.

3. For the units noted in Number 1 above and also those hazardous waste units in your Part A application, please describe for each unit any data available on any prior or current releases of hazardous wastes or constituents to the environment that may have occurred in the past or may still be occurring.

Please provide the following information

a. Date of release
b. Type of waste released
c. Quantity or volume of waste released
d. Describe nature of release (i.e., spill, overflow, ruptured pipe or tank, etc.)

(See attached sheet.)

4. In regard to the prior or continuing releases described in Number 3 above, please provide (for each unit) any analytical data that may be available which would describe the nature and extent of environmental contamination that exists as a result of such releases. Please focus on concentrations of hazardous wastes or constituents present in contaminated soil or groundwater.

No such data is available.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the submittal is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. (42 U.S.C. 6902 et seq. and 40 CFR 270.11(d))

George Miller, Maintenance Superintendent
Typed Name and Title

George Miller
Signature

March 18, 1986
Date

Attachment to
Certification Regarding Potential Releases
from Solid Waste Management Units

2. Container Storage Area - In the area marked "A" on the site plan, which currently is used for drum storage of non-hazardous materials, drums of spent solvent were stored until approximately 1980.

Waste Treatment, Detoxification - For a period beginning in the early 1960's, Techalloy treated its acid wash water (spent pickle liquor) by neutralizing it with ammonia, then filtering it through a limestone-filled, in-ground holding bed lined with steel behind its acid house. The bed is marked with an "A" on the enclosed site plan. The filtered, neutralized acid then traveled through a ceramic drainage tile to a dry-bed "pond" where the liquid evaporated. The pond is approximately 20 feet wide and 150 feet long and is located at site "B" on the plan. The pickling solution consisted of dilute hydrofloric, sulfuric, muriatic and nitric acids. In 1969 or 1970, the drainage tile was closed off, but the limestone bed was still utilized in tandem with a clarifying tanker until approximately 1980.

Since 1968 or 1969, Techalloy has intermittently operated a copper coating process in which wire is washed first in a nickle plating bath of dilute nickle sulfate, then rinsed over a well with large quantities of water. The wire is then lowered into a dilute cyanide bath, then rinsed over the well with large quantities of water. These two baths sit in tanks in a well at site C on the plan. From that time until 1978, overflow from the well was occasionally drained by a sump pump, through a pipe and discharged onto the ground at location D on the plan. This method of removing overflow was changed in 1979 and the sump pump was removed.

Techalloy occasionally utilized 1,1,1-trichlorethane in its process for several years. For an unknown period of time, until 1978, Techalloy treated some of its spent solvent by evaporation outdoors on a cement pad, marked E on the site plan. Although Techalloy has no direct knowledge of this, it is possible that some of the TCE placed upon the pad for evaporation spilled onto the ground adjacent to the pad. The quantities of TCE evaporated in this way were small, and cannot be determined with any more precision from records in existence at the present time.

3. (a) In June, 1985, it was discovered that the well containing the pickling tanks had a leak through two cracks in the 10-inch thick wall of the well.

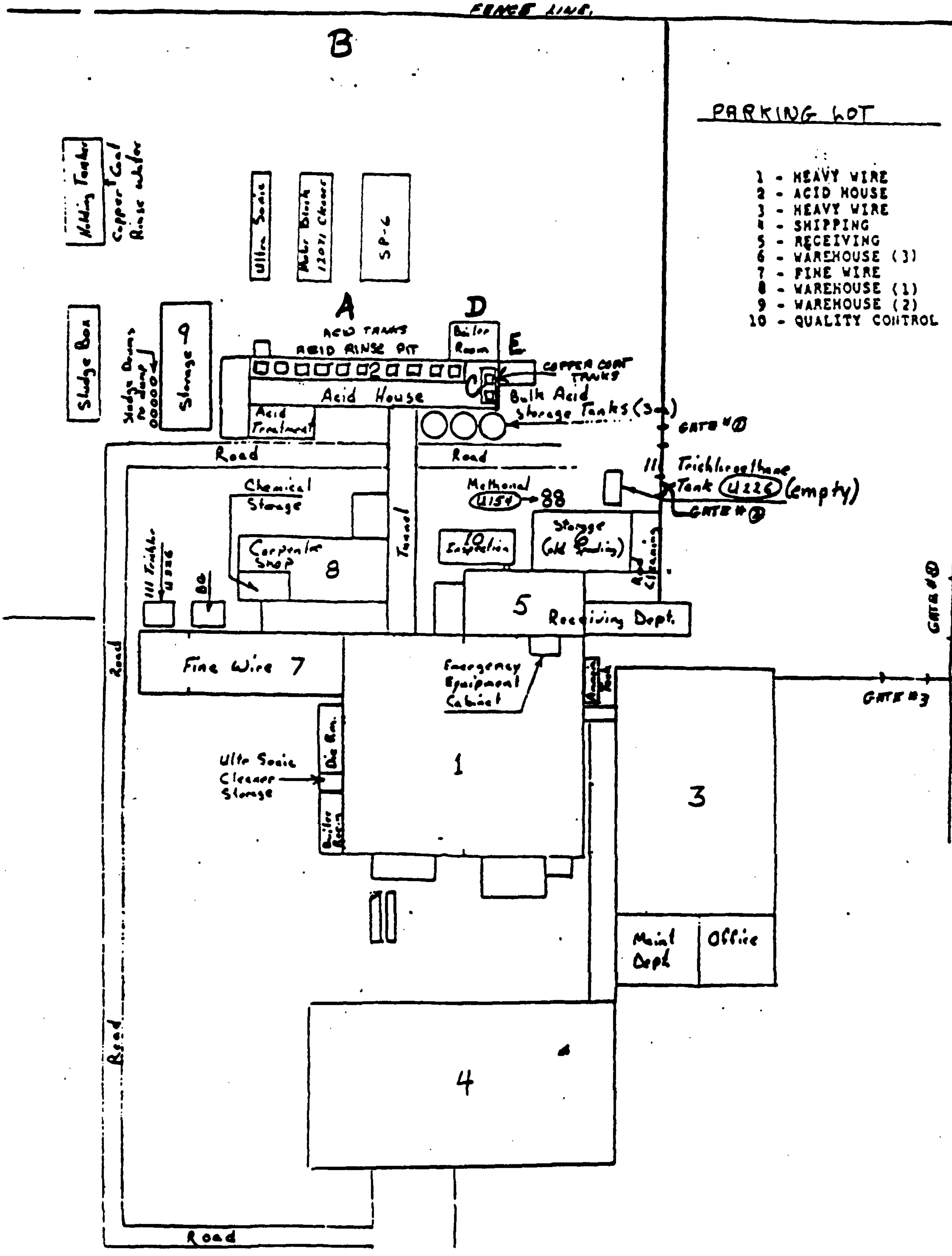
(b) The material was extremely dilute acid wash water (spent pickle liquor) and treated, neutralized pickle liquor.

(c) The quantity of the leak was not measured, but is believed to be small given the size of the cracks discovered.

(d) By digging the dirt away from the outside wall, Techalloy discovered one pinhole-type crack and another larger crack about 36 inches long. These were repaired with cement and epoxy.

Up-dated Storage Plan

12-3-85



EPA U.S. ENVIRONMENTAL PROTECTION AGENCY

NOTIFICATION OF HAZARDOUS WASTE ACTIVITY

INSTALLATION'S EPA I.D. NO.

I. NAME OF INSTALLATION

II. INSTALLATION MAILING ADDRESS

III. LOCATION OF INSTALLATION

PLEASE PLACE LABEL IN THIS SPACE

INSTRUCTIONS: If you received a preprinted label, affix it in the space at left. If any of the information on the label is incorrect, draw a line through it and supply the correct information in the appropriate section below. If the label is complete and correct, leave Items I, II, and III below blank. If you did not receive a preprinted label, complete all items. "Installation" means a single site where hazardous waste is generated, treated, stored and/or disposed of, or a transporter's principal place of business. Please refer to the INSTRUCTIONS FOR FILING NOTIFICATION before completing this form. The information requested herein is required by law (Section 3010 of the Resource Conservation and Recovery Act).

DETACH

FOR OFFICIAL USE ONLY

COMMENTS

C

INSTALLATION'S EPA I.D. NUMBER	APPROVED	DATE RECEIVED (yr., mo., & day)
F		

I. NAME OF INSTALLATION

TECHALLOY COMPANY, INC.

II. INSTALLATION MAILING ADDRESS

STREET OR P.O. BOX

3 P O BOX 423

CITY OR TOWN	ST.	ZIP CODE
4 UNION	IL	60180

III. LOCATION OF INSTALLATION

STREET OR ROUTE NUMBER

5 OLSON AND JEFFERSON ROADS

CITY OR TOWN	ST.	ZIP CODE
6 UNION	IL	60180

IV. INSTALLATION CONTACT

NAME AND TITLE (last, first, & job title)	PHONE NO. (area code & no.)
2 MILLER GEORGE R. MAINT SUPT	815 923 2131

V. OWNERSHIP

A. NAME OF INSTALLATION'S LEGAL OWNER

8 TECHALLOY COMPANY, INC

DETACH

B. TYPE OF OWNERSHIP (enter the appropriate letter into box)

F = FEDERAL
M = NON-FEDERAL

M

VI. TYPE OF HAZARDOUS WASTE ACTIVITY (enter "X" in the appropriate box(es))

- [x] A. GENERATION
- [ ] B. TRANSPORTATION (complete item VII)
- [ ] C. TREAT/STORE/DISPOSE
- [ ] D. UNDERGROUND INJECTION

VII. MODE OF TRANSPORTATION (transporters only — enter "X" in the appropriate box(es))

- [ ] A. AIR
- [ ] B. RAIL
- [ ] C. HIGHWAY
- [ ] D. WATER
- [ ] E. OTHER (specify):

MAR 18 1991

VIII. FIRST OR SUBSEQUENT NOTIFICATION

Mark "X" in the appropriate box to indicate whether this is your installation's first notification of hazardous waste activity or a subsequent notification. If this is not your first notification, enter your installation's EPA I.D. Number in the space provided below.

- [ ] A. FIRST NOTIFICATION
- [x] B. SUBSEQUENT NOTIFICATION (complete item C)

C. INSTALLATION'S EPA I.D. NO.

ILD005178975

IX. DESCRIPTION OF HAZARDOUS WASTES

Please go to the reverse of this form and provide the requested information.

I.D. – FOR OFFICIAL USE ONLY

W | | 1

DESCRIPTION OF HAZARDOUS WASTES *(continued from front)*

A. HAZARDOUS WASTES FROM NON–SPECIFIC SOURCES. Enter the four–digit number from 40 CFR Part 261.31 for each listed hazardous waste from non–specific sources your installation handles. Use additional sheets if necessary.

1	2	3	4	5	6
F008					
7	**8**	**9**	**10**	**11**	**12**

B. HAZARDOUS WASTES FROM SPECIFIC SOURCES. Enter the four–digit number from 40 CFR Part 261.32 for each listed hazardous waste from specific industrial sources your installation handles. Use additional sheets if necessary.

13	14	15	16	17	18
K062					
19	**20**	**21**	**22**	**23**	**24**
25	**26**	**27**	**28**	**29**	**30**

C. COMMERCIAL CHEMICAL PRODUCT HAZARDOUS WASTES. Enter the four–digit number from 40 CFR Part 261.33 for each chemical substance your installation handles which may be a hazardous waste. Use additional sheets if necessary.

31	32	33	34	35	36
37	**38**	**39**	**40**	**41**	**42**
43	**44**	**45**	**46**	**47**	**48**

D. LISTED INFECTIOUS WASTES. Enter the four–digit number from 40 CFR Part 261.34 for each listed hazardous waste from hospitals, veterinary hospitals, medical and research laboratories your installation handles. Use additional sheets if necessary.

49	50	51	52	53	54

E. CHARACTERISTICS OF NON–LISTED HAZARDOUS WASTES. Mark "X" in the boxes corresponding to the characteristics of non–listed hazardous wastes your installation handles. *(See 40 CFR Parts 261.21 – 261.24)*

- [ ] 1. IGNITABLE (D001)
- [ ] 2. CORROSIVE (D002)
- [X] 3. REACTIVE (D003)
- [ ] 4. TOXIC (D000)

X. CERTIFICATION

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

SIGNATURE	NAME & OFFICIAL TITLE (type or print)	DATE SIGNED
	Henry Lopes, Vice President	

EPA Form 8700-12 (6-85) REVERSE

Revised
7 March 1990*

Attachment 1

CERTIFICATION REGARDING POTENTIAL RELEASES FROM SOLID WASTE MANAGEMENT UNITS

FACILITY NAME: Techalloy Company, Inc.

EPA I.D. NUMBER: ILD005178975

LOCATION CITY: Union

STATE: IL

1. Are there any of the following solid waste management units (existing or closed) at your facility? NOTE - DO NOT INCLUDE HAZARDOUS WASTES UNITS CURRENTLY IDENTIFIED IN THE PART A APPLICATION, PART B APPLICATION, OR ANY CLOSURE PLAN FOR THE FACILITY.

	YES	NO
- Landfill		X
- Surface Impoundment		X
- Land Farm		X
- Waste Pile		X
- Incinerator		X
- Storage Tank (Above Ground)		X
- Storage Tank (Underground)		X
- Container Storage Area	X	
- Injection Wells		X
- Wastewater Treatment Units		X
- Transfer Stations		X
- Waste Recycling Operations		X
- Waste Treatment, Detoxification		X
- Other ______		

2. If there are "yes" answers to any of the items in Number 1 above, please provide a description of the wastes that were stored, treated or disposed of in each unit. In particular, please focus on whether or not the wastes would be considered as hazardous wastes or hazardous constituents under RCRA. Also include any available data on quantities or volume of wastes disposed on and the dates of disposal. Please also provide a description of each unit and include capacity, dimensions, location at facility, provide a site plan if available.

(See Attchment A for this description)

NOTE: Hazardous waste are those identified in 40 CFR 261. Hazardous constituents are those listed in Appendix VIII of 40 CFR Part 261.

3. For the units noted in Number 1 above and also those hazardous waste units identified in your Part A, Part B or any closure plan, please describe (for each unit) any data available on any prior or current releases of hazardous wastes or constituents to the environment that may have occurred in the past or that may still be occurring.

RECEIVED

MAR 18 1991

IEPA-DLPC

*See Attachment B for original submittal.

Please provide the following information

a. Date of release
b. Type of waste released
c. Quantity or volume of waste released
d. Describe nature of release (i.e., spill, overflow, ruptured pipe or tank, etc.)

____

____

____

____

4. In regard to the prior releases described in Number 3 above, please provide (for each unit) any analytical data that may be available which would describe the nature and extent of environmental contamination that exists as a result of such releases. Please focus on concentrations of hazardous wastes or constituents present in contaminated soil or groundwater.

____

____

____

____

I certify under the penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the submittal is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. (42 U.S.C. 6902 et seq. and 40 CFR 270.11(d))

____
Typed Name and Title

______________________ ______________
Signature Date

JM:mab/S14j/sp/4-5

ATTACHMENT A

ADDENDUM TO CERTIFICATION
REGARDING POTENTIAL RELEASES FROM
SOLID WASTE MUNICIPAL SITES

2. Under Item 1, underground storage tanks and container storage areas were checked as present at the facility:

• Pickling rinse waters	KO62 waste, acidic and caustic, presently stored in two tanks, 10,500 gallons and 16,500 gallons. No information on quantities or volume of waste which leaked from a crack in the sidewall. This leak was patched in July, 1985. Identified as M on the attached plot plan.
• Plating filters	Hazardous stored in drums. Drums are stored at Q on the attached plot plan. No spills have occured.
• ADS Sludge	Identified as P on the attached plot plan. Hazardous, stored in drums. No spills have occured.
• Metal hydroxide Sludge	Hazardous, stored in hopper at R. No waste has been treated since 1988, therefore no sludge has been generated since 1988.
• SP-6 Sludge	Special waste, non-hazardous. Stored at P with sludge drums. No spills recorded.
• Waste oils	Special, stored in drums at P. No spills recorded.
• MbS_2 process filters	Special, no apparent hazardous constituents as identified in Appendix A of 40 CFR 261. Stored at N. Only one drum was generated prior to the 1990 IEPA inspection. No current generation, no spills recorded.

3. As indicated on the Certification Form and as requested in Item 11 of the Closure Plan, it appears that, at some time in the past, trichloroethane, which was used as a degreasing fluid at the facility, leaked or spilled at the facility. It appears that this may have occurred at either point E or at point S, or both, as shown on the attached plot plan. The area at E was used for hand degreasing, heavy stainless rods, using rags. The data available is the current data collected in the groundwater investigation at the facility beginning in approximately December 1989 and continuing through the present time. WESTON and Techalloy have this data. No trichloroethane is currently used on the property. The plume has been described. Quantity of waste released is not known.

4. See No. 3 above regarding available data. The ranges of contamination in the soil are from non-detectable to 1 million parts per billion. The concentrations of trichloroethane in the groundwater range from non-detectable to 15,000 ppb.

Attachment B

CERTIFICATION REGARDING POTENTIAL RELEASES FROM SOLID WASTE MANAGEMENT UNITS

FACILITY NAME: Techalloy Illinois, Inc.

EPA I.D. NUMBER: ILD005178975

LOCATION CITY: Olsen and Jefferson Roads, Union

STATE: Illinois

1. Are there any of the following solid waste management units (existing or closed) at your facility? NOTE - DO NOT INCLUDE HAZARDOUS WASTE UNITS CURRENTLY SHOWN IN YOUR PART A APPLICATION

	YES	NO
• Landfill		X
• Surface Impoundment		X
• Land Farm		X
• Waste Pile		X
• Incinerator		X
• Storage Tank (Above Ground)		X
• Storage Tank (Underground)		X
• Container Storage Area	X	
• Injection Wells		X
• Wastewater Treatment Units		X
• Transfer Stations		X
• Waste Recycling Operations		X
• Waste Treatment, Detoxification	X	
• Other ______		

2. If there are "Yes" answers to any of the items in Number 1 above, please provide a description of the wastes that were stored, treated or disposed of in each unit. In particular, please focus on whether or not the wastes would be considered as hazardous wastes or hazardous constituents under RCRA. Also include any available data on quantities or volume of wastes disposed of and the dates of disposal. Please also provide a description of each unit and include capacity, dimensions and location at facility. Provide a site plan if available.

(See attached sheet.)

RECEIVED

MAR 18 1991

IEPA-DLPC

NOTE: Hazardous wastes are those identified in 40 CFR 261. Hazardous constituents are those listed in Appendix VIII of 40 CFR Part 261.

3. For the units noted in Number 1 above and also those hazardous waste units in your Part A application, please describe for each unit any data available on any prior or current releases of hazardous wastes or constituents to the environment that may have occurred in the past or may still be occurring.

Please provide the following information

a. Date of release
b. Type of waste released
c. Quantity or volume of waste released
d. Describe nature of release (i.e., spill, overflow, ruptured pipe or tank, etc.)

(See attached sheet.)

4. In regard to the prior or continuing releases described in Number 3 above, please provide (for each unit) any analytical data that may be available which would describe the nature and extent of environmental contamination that exists as a result of such releases. Please focus on concentrations of hazardous wastes or constituents present in contaminated soil or groundwater.

No such data is available.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the submittal is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. (42 U.S.C. 6902 et seq. and 40 CFR 270.11(d))

George Miller, Maintenance Superintendent
Typed Name and Title

George Miller
Signature

March 18, 1986
Date

Attachment to
Certification Regarding Potential Releases
from Solid Waste Management Units

---

2. Container Storage Area - In the area marked "A" on the site plan, which currently is used for drum storage of non-hazardous materials, drums of spent solvent were stored until approximately 1980.

Waste Treatment, Detoxification - For a period beginning in the early 1960's, Techalloy treated its acid wash water (spent pickle liquor) by neutralizing it with ammonia, then filtering it through a limestone-filled, in-ground holding bed lined with steel behind its acid house. The bed is marked with an "A" on the enclosed site plan. The filtered, neutralized acid then traveled through a ceramic drainage tile to a dry-bed "pond" where the liquid evaporated. The pond is approximately 20 feet wide and 150 feet long and is located at site "B" on the plan. The pickling solution consisted of dilute hydrofloric, sulfuric, muriatic and nitric acids. In 1969 or 1970, the drainage tile was closed off, but the limestone bed was still utilized in tandem with a clarifying tanker until approximately 1980.

Since 1968 or 1969, Techalloy has intermittently operated a copper coating process in which wire is washed first in a nickle plating bath of dilute nickle sulfate, then rinsed over a well with large quantities of water. The wire is then lowered into a dilute cyanide bath, then rinsed over the well with large quantities of water. These two baths sit in tanks in a well at site C on the plan. From that time until 1978, overflow from the well was occasionally drained by a sump pump, through a pipe and discharged onto the ground at location D on the plan. This method of removing overflow was changed in 1979 and the sump pump was removed.

Techalloy occasionally utilized 1,1,1-trichlorethane in its process for several years. For an unknown period of time, until 1978, Techalloy treated some of its spent solvent by evaporation outdoors on a cement pad, marked E on the site plan. Although Techalloy has no direct knowledge of this, it is possible that some of the TCE placed upon the pad for evaporation spilled onto the ground adjacent to the pad. The quantities of TCE evaporated in this way were small, and cannot be determined with any more precision from records in existence at the present time.

3. (a) In June, 1985, it was discovered that the well containing the pickling tanks had a leak through two cracks in the 10-inch thick wall of the well.

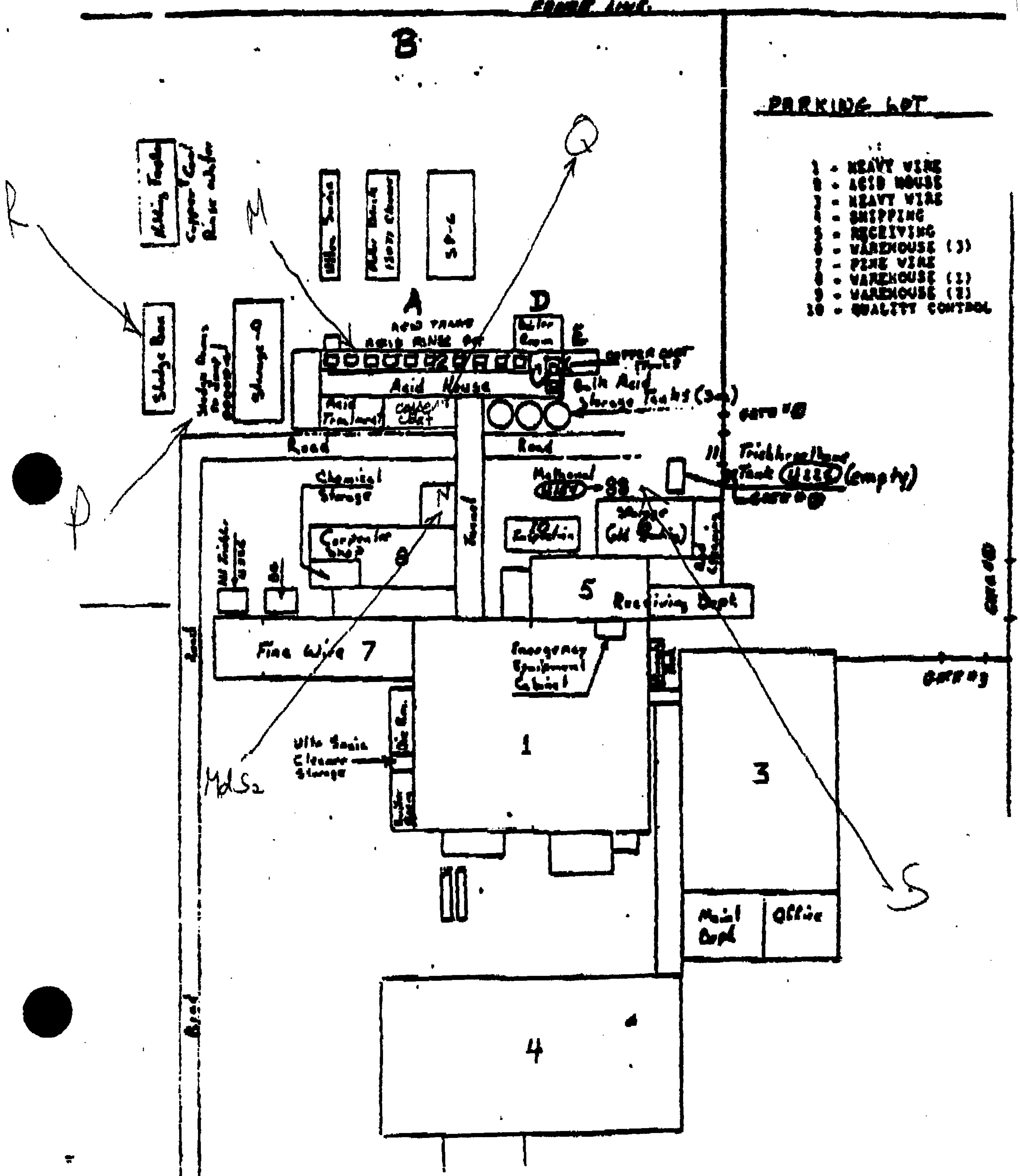
(b) The material was extremely dilute acid wash water (spent pickle liquor) and treated, neutralized pickle liquor.

(c) The quantity of the leak was not measured, but is believed to be small given the size of the cracks discovered.

(d) By digging the dirt away from the outside wall, Techalloy discovered one pinhole-type crack and another larger crack about 36 inches long. These were repaired with cement and epoxy.

Up-dated Storage Plan

12-3-86



Attachment 3
Techalloy Groundwater Data Summary

Compound	MW-1	MW-2	MW-3	MW-4	MW-5	MW-5D
Methylene Chloride	ND	ND	ND	ND	5	4
1,1-Dichloroethene	ND	100	ND	190	210	5
1,1-Dichloroethane	ND	86	ND	200	95	6
1,2-Dichloroethene (total)	ND	30	ND	97	8	2
1,2-Dichloroethane	ND	3000	ND	ND	ND	ND
1,1,1-Trichloroethane	ND	100	ND	6000	5600	310
Trichloroethene	ND	11	ND	270	110	300
1,1,2-Trichloroethane	ND	ND	ND	18	9	ND
Tetrachloroethene	ND	76	ND	1000	620	ND
Acetone	ND	26	ND	ND	29	13
Chloroform	ND	ND	ND	ND	ND	ND
Benzene	ND	ND	ND	ND	ND	ND
4-Methyl-2-Pentanone	ND	16	ND	ND	ND	ND
Carbon Tetrachloride	ND	ND	ND	ND	ND	ND

Compound	MW-6	MW-7	MW-8	MW-9	HBR	6211
Methylene Chloride	5	ND	ND	8	10	ND
1,1-Dichloroethene	ND	ND	ND	ND	120	ND
1,1-Dichloroethane	ND	ND	ND	ND	5	ND
1,2-Dichloroethene (total)	ND	ND	ND	ND	8	ND
1,2-Dichloroethane	ND	ND	ND	ND	8	ND
1,1,1-Trichloroethane	39	ND	ND	18	3700	ND
Trichloroethene	ND	ND	ND	ND	24	ND
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND
Tetrachloroethene	52	ND	ND	3	320	ND
Acetone	ND	ND	ND	25	ND	ND
Chloroform	ND	ND	ND	ND	ND	ND
Benzene	ND	ND	ND	ND	ND	ND
4-Methyl-2-Pentanone	36	ND	ND	ND	ND	ND
Carbon Tetrachloride	ND	ND	ND	ND	ND	ND

All values in ppb
ND - Not detected.

Attachment 3 (continued)
Techalloy Groundwater Data Summary

Compound	6212	6304	6105	6201	6402	17422
Methylene Chloride	ND	ND	ND	ND	ND	ND
1,1-Dichloroethene	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	ND	ND	ND	ND	2	ND
1,2-Dichloroethene (total)	ND	ND	ND	ND	ND	ND
1,2-Dichloroethane	ND	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	ND	4	ND	ND	ND	9
Trichloroethene	ND	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND
Tetrachloroethene	ND	2	ND	ND	ND	ND
Acetone	ND	ND	ND	ND	ND	ND
Chloroform	ND	4	ND	ND	ND	ND
Benzene	ND	ND	ND	ND	ND	ND
4-Methyl-2-Pentanone	ND	ND	ND	ND	ND	ND
Carbon Tetrachloride	ND	2	ND	ND	ND	ND

All values in ppb.
ND - Not detected.

Southern California Chemical

CHEMICAL QUALITY OF GROUND WATER IN MONITORING WELLS AND UNION WELL #3 - INORGANIC PARAMETERS

PARAMETER	UNITS	WELL IDENTIFICATION (Screened interval, ft)						
		W-1 (57-67)	W-1A (8-18)	W-2 (28-38)	W-2B (DUPLI-CATE) (28-38)	W-3 (63-73)	W-4 (6-11)	UNION WELL #3 (60-80)
Alkalinity, Total (CaCO3)	mg/L	348	212	644	628	376	356	380
Chloride	mg/L	94	8	1410	1320	158	39	670
Hardness, Total (CaCO3)	mg/L	312	264	<1	<1	472	344	952
Nitrogen, Ammonia	mg/L	13	2.7	370	360	1.7	0.19	36
Nitrogen, Nitrate	mg/L	0.73	9.0	0.24	0.16	1.01	0.12	0.04
pH	units	7.02	7.30	6.66	6.66	7.20	8.40	7.08
Sulfate	mg/L	87	67	4000	3400	320	72	700
Arsenic	mg/L	<0.001	0.001	0.002	0.002	<0.001	0.002	0.001
Barium	mg/L	1.39	0.200	0.088	0.106	0.802	0.169	0.124
Cadmium	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calcium	mg/L	62.2	371	635	637	93.8	368	250
Chromium, Total	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	mg/L	0.03	0.04	0.02	0.11	0.03	<0.01	<0.01
Iron	mg/L	1.17	3.20	6.72	30.1	2.21	2.04	7.05
Lead	mg/L	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Magnesium	mg/L	44.5	100	338	333	56.4	116	102
Manganese	mg/L	0.07	3.80	3.59	3.21	0.12	0.85	0.18
Mercury	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Nickel	mg/L	<0.01	0.04	0.07	0.07	<0.01	<0.01	0.02
Potassium	mg/L	7.60	4.63	23.5	23.7	6.15	1.36	25.9
Selenium	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Silver	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Sodium	mg/L	79.6	8.43	356	335	50.7	29.2	266
Zinc	mg/L	0.789	0.422	0.230	0.275	0.506	0.037	0.007

Notes:

Union Well #3 sampled on March 21, 1990
Monitor wells sampled on April 3, 1990

(1c/q-t(90)sccc-5-A.tbl)

Southern California Chemical

CHEMICAL QUALITY OF GROUND WATER IN MONITORING WELLS AND UNION WELL #3 - VOLATILE ORGANIC COMPOUNDS

PARAMETER	UNITS	WELL IDENTIFICATION (Screened interval, ft)						
		W-1 (57-67)	W-1A (8-18)	W-2 (28-38)	W-2B (DUPLICATE) (28-38)	W-3 (63-73)	W-4 (6-11)	UNION WELL #3 (60-80)
Benzene	µg/L			1.8				
1,1-dichloroethane	µg/L			7.3	9.8			
1,2-dichloroethane	µg/L				2.6			
1,1-dichloroethene	µg/L		2.0		1.3			
Cis-1,2-dichloroethene	µg/L			4.5	5.7			
1,2-dichloropropane	µg/L			19.0	29.7			
Toluene	µg/L			2.3				
Trichloroethene	µg/L	2.6		1.5	2.1			
Tetrachloroethene	µg/L		1.4					
1,1,1-trichloroethane	µg/L		1.6					

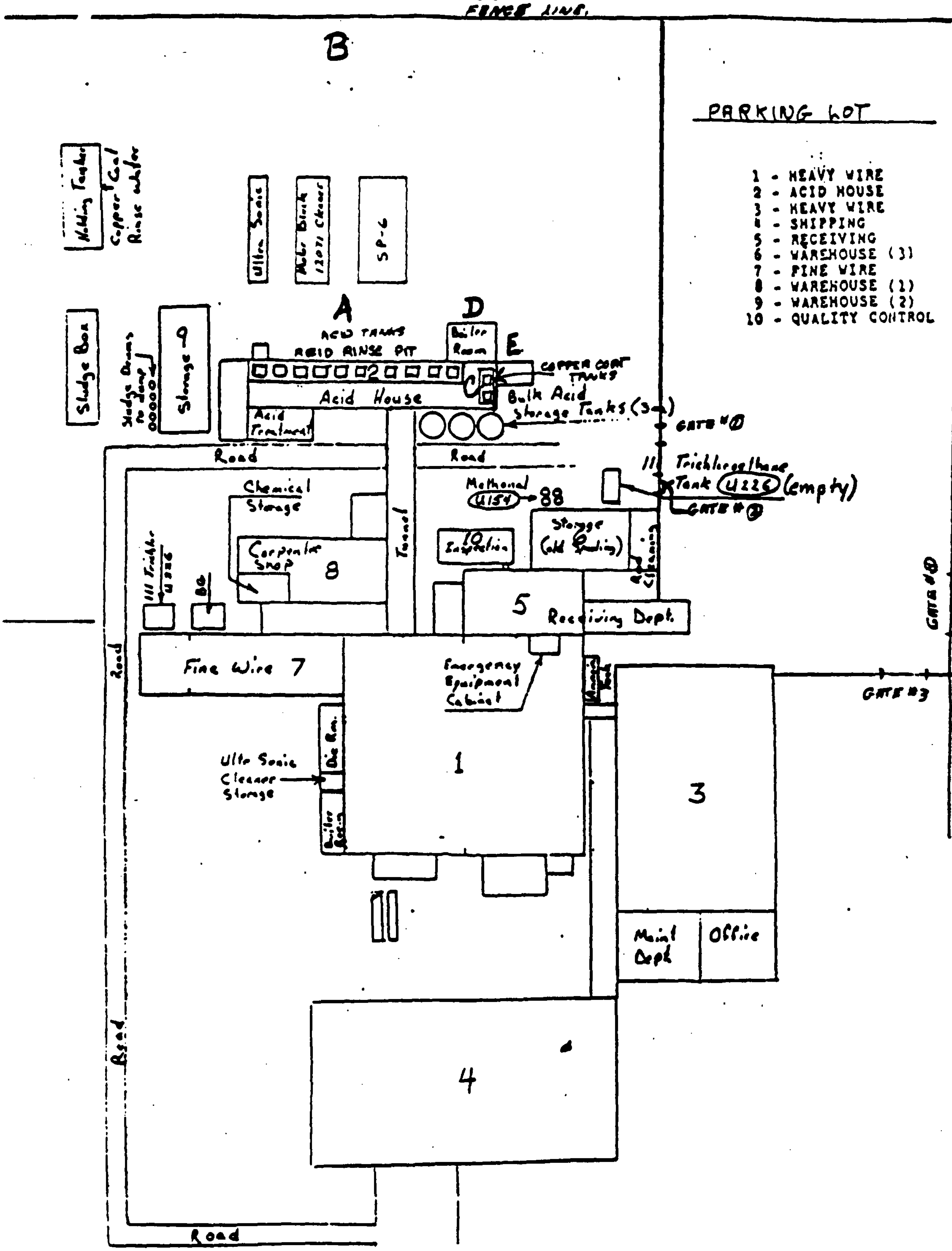
Notes:

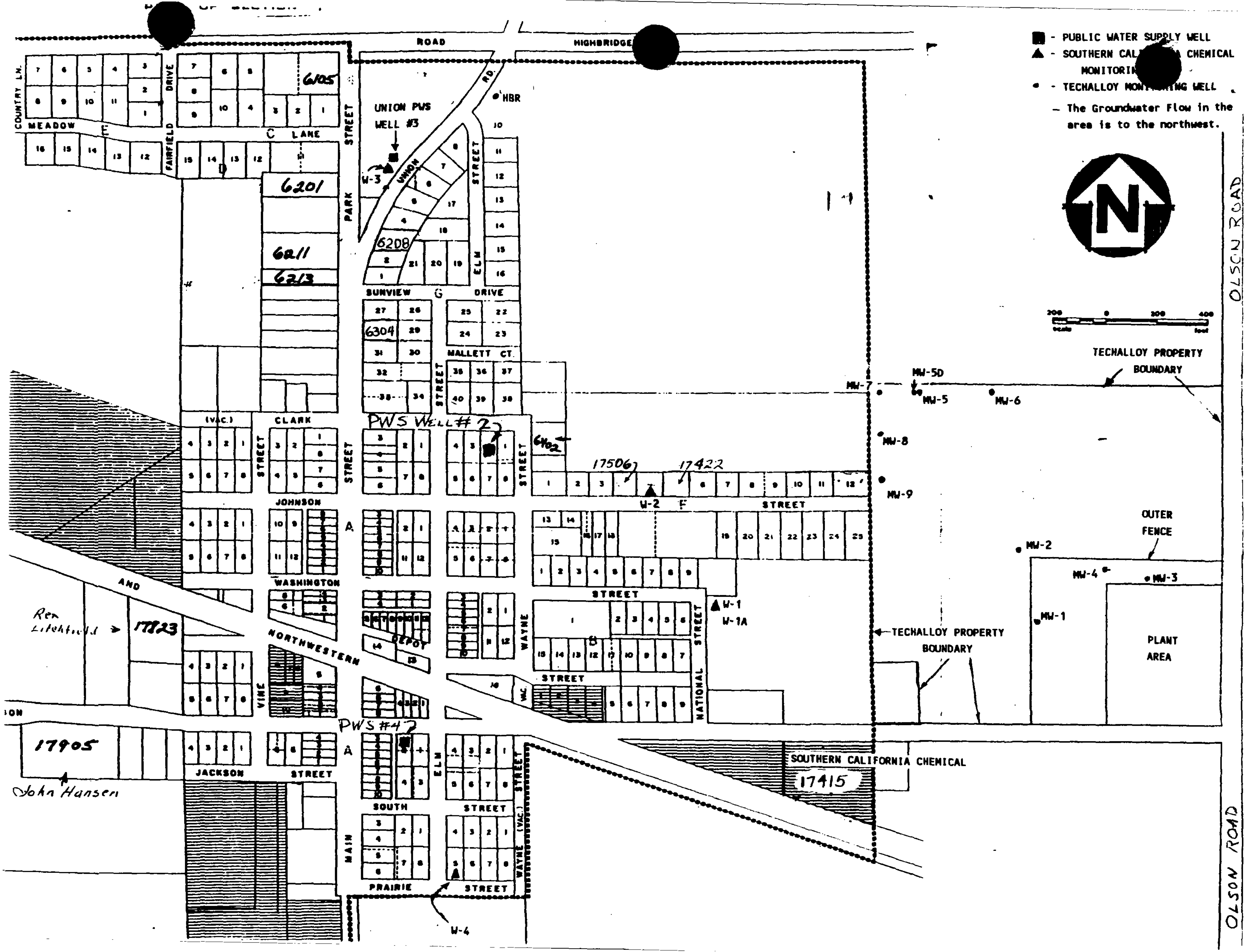
Union Well #3 sampled on March 21, 1990
Monitor wells sampled on April 3, 1990
Blank indicates below detection limit

[1c/q-t(90)sccc-5-B.tbl]

Up-dated Storage Plan

12-3-85





- PUBLIC WATER SUPPLY WELL
- TECHALLOY MONITORING WELL
— The Groundwater Flow in the area is to the northwest.
N
HIGHBRIDGE ROAD
OLSON ROAD
UNION PWS WELL #3
HBR
W-3
6105
6201
6208
6211
6213
6304
6402
PWS WELL #2
PWS #4
17506
17422
17823
17905
17415
Ren Litchfield
John Hansen
COUNTRY LN.
MEADOW LANE
FAIRFIELD DRIVE
PARK STREET
UNION RD.
ELM STREET
SUNVIEW DRIVE
MALLETT CT.
CLARK STREET
JOHNSON STREET
WASHINGTON STREET
NORTHWESTERN
DEPOT
VINE STREET
JACKSON STREET
SOUTH STREET
MAIN STREET
PRAIRIE STREET
WAYNE STREET
NATIONAL STREET
W-1
W-1A
W-2
W-4
MW-1
MW-2
MW-3
MW-4
MW-5
MW-5D
MW-6
MW-7
MW-8
MW-9
TECHALLOY PROPERTY BOUNDARY
OUTER FENCE
PLANT AREA
SOUTHERN CALIFORNIA CHEMICAL